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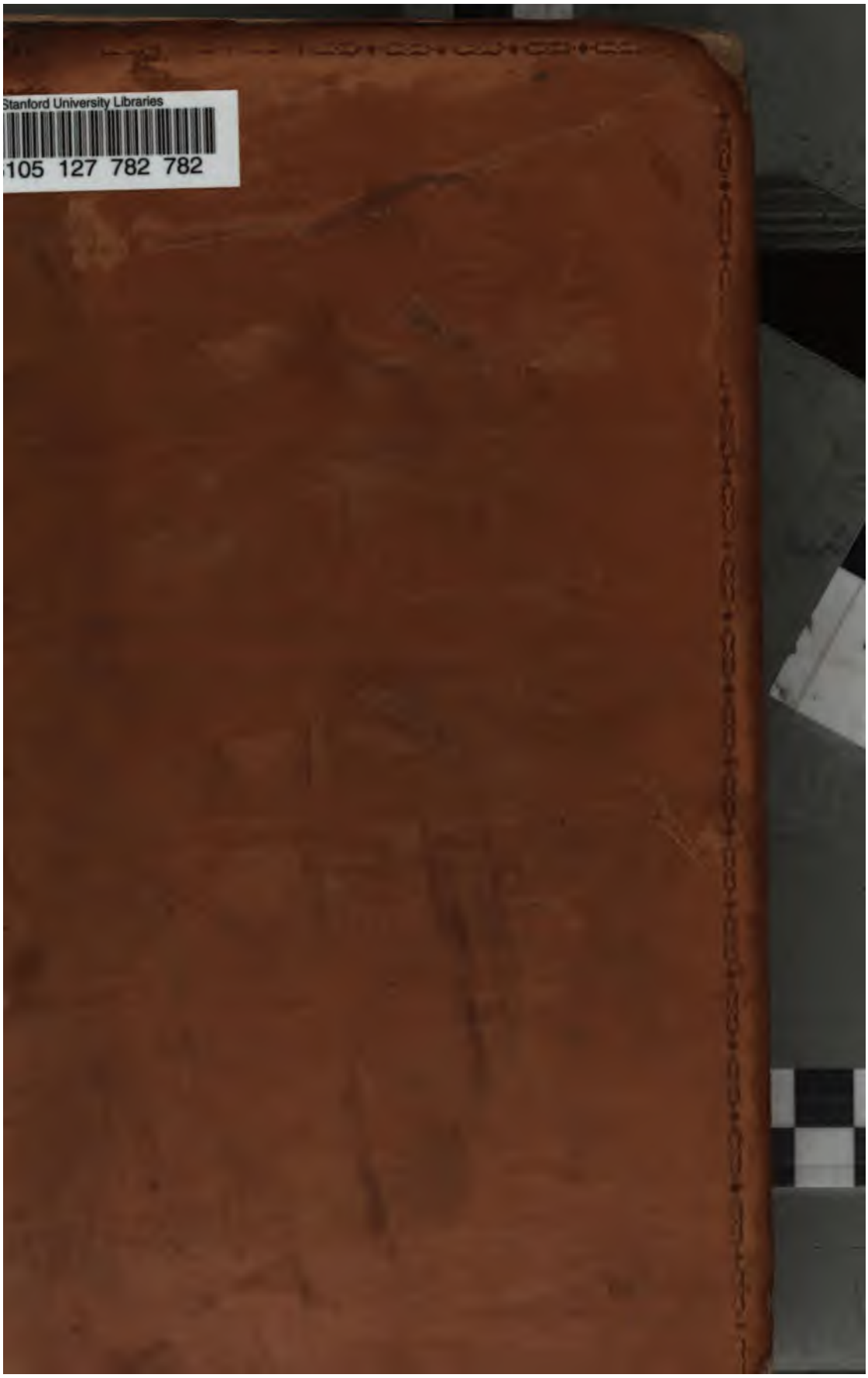
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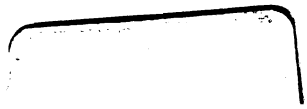

INDEX

TO

EXECUTIVE DOCUMENTS

PRINTED BY ORDER OF

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DURING

THE FIRST SESSION OF THE THIRTY-FIRST CONGRESS,

1849–'50.

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INDEX

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Volume 1 *contains*	-	*No.* 1, *part* 1.
Volume 2 *contains*	-	*No.* 1, " 2.
Volume 3 *contains*	-	*No.* 1, " 3.
Volume 4 *contains*	-	*No.* 2.
Volume 5 *contains*	-	*No.* 3 *to* 5 *inclusive.*
Volume 6 *contains*	-	*No.* 6 *to* 28, *except Nos.* 15 *and* 16.
Volume 7 *contains*	-	*No.* 15, *part* 1.
Volume 8 *contains*	-	*No.* 15, " 2.
Volume 9 *contains*	-	*No.* 18.
Volume 10 *contains*	-	*No.* 29 *to* 48, *except No.* 39.
Volume 11 *contains*	-	*No.* 39, *part* 1.
Volume 12 *contains*	-	*No.* 39, " 2.
Volume 13 *contains*	-	*No.* 49 *to* 63 *inclusive.*
Volume 14 *contains*	-	*No.* 64 *to* 82 *inclusive.*

A.

	Vol.	No.	Page.
Academy at West Point, for 1849. Report of the board of visitors of the Military - - - -	1	1	235
Adjutant General of the army, with returns, position, and distribution of the troops, in 1849. Report of the	1	1	179
Admiralty against foreign vessels entering the ports of the United States, &c. Correspondence relative to suits instituted in the courts of - - -	14	78	1
Africa, and the annual cost of that squadron. Report of the annual number of deaths in the United States squadron on the coast of - - - -	10	40	1
Agriculture, agricultural statistics, meteorology, &c. Report of the Commissioner of Patents, with a general view of American - - - - -	8	15	1
(See table of contents, at page 3, *of above.)*			
American vessels by British ships of war. Correspondence relative to the searching of - - -	14	66	1

	Vol.	No.	Pag
Appropriations for the service of the State Department, including foreign missions, during the year 1849. Statements showing the disbursements of -	10	30	
Appropriations for the naval service for the fiscal year ending 30th June, 1849. Statement of - -	1	1	76
Appropriations for the naval service during the year ending 30th June, 1849. Statement of transfers of -	6	7	
Appropriations and expenditures for the service of the War Department during the fiscal year ending June 30, 1849. Statement of - - -	6	10	
Arms, percussion powder, and caps in France, Belgium, Holland, and England. Report of Brevet Major Hagner, in relation to the mode of manufacturing -	1	1	37
Armories and arsenals during the fiscal year ending 30th June, 1849. Statement of the principal operations at the - - - - - - -	1	1	36
Armories, and the number of arms and appendages made and repaired during the year ending 30th June, 1849. Statement of the expenses of the national	6	27	
Army in 1849, (part 1.) Report of Major General Scott on the state and operations of the - -	1	1	9
Army, with returns, position, and distribution of the troops in 1849, (part 1.) Annual report of the Adjutant General of the - - - -	1	1	17
Army for the year 1849. Annual report of the Quartermaster General of the - - - -	1	1	19
Army operations in New Mexico, in 1849. Report of the	1	1	10
Army operations in Florida, in 1849. Report of the -	1	1	11
Army operations in Texas, in 1849. Report of the -	1	1	13
Army for 1849. Annual report of the Paymaster General of the - - - - - -	1	1	19
Army for 1849. Annual report of the Commissary General of the - - - - - -	1	1	20
Army for 1849. Annual report of the Surgeon General of the - - - - - -	1	1	20
Army of the United States in Texas, and the adjacent Mexican states on the Rio Grande, accompanied by astronomical observations, and descriptive and military memoirs of the country. Report of Secretary of War, with a map showing the operations of the - - - - - -	10	32	
Army operations on the Rio Grande. Report of the Secretary of War of the - - - -	14	73	
Arsenals and armories during the year ending 30th June, 1849. Statement of the principal operations at the	1	1	36
Arts and manufactures for the year 1849. Report of the Commissioner of Patents in relation to - -	7	15	
Assistant Postmaster General. (See *Postmaster General.*)			
Auditor of the Post Office Department, accompanying the annual report of the Postmaster General. Report of the - - - - - - -	1	1	78

	Vol.	No.	Page.
Auditor's office during the year ending 30th September, 1849. Abstract of expenditures under the head of contingent expenses of the navy, as settled at the Fourth	1	1	764
Auditor of the Treasury, with copies of accounts of disbursements for the benefit of the Indians. Report of the Second	10	41	1
Auditor of the Treasury of the disbursement of moneys, &c., for the benefit of the Indians. Report of the Second	5	4	1
Auditor of the Treasury, with a statement of the claims of the Cherokee nation of Indians, according to the principles established by the treaty of August, 1846. Report of the Second Comptroller and Second	6	6	1
Austria. Correspondence with the agent employed to visit Hungary during the recent war between that country and	10	48	1

B.

Black river. (See *River*.)			
Bodisco, the Russian minister. Report in relation to the measures taken by the Secretary of State on the memorial of the great grandnephew and attorney of the heirs of General Kosciusko against Alexandre de	13	50	1
Botanical specimens collected in the primitive region south of Lake Superior. Catalogue of	3	1	876
Boundary line between the United States and New Mexico. Operations of the commission to run and mark the	10	34	1
Boundary line between the British and French possessions in North America, as fixed by the treaty of Utrecht. Extract of a letter from Mr. Everett, United States minister at London, to Mr. Webster, Secretary of State, relative to the	14	71	1
Bounty land warrants. (See *Land*.)			
Brazos de St. Jago. Message of the President relative to the commerce of the port of	14	69	1
British chargé d'affaires for Chili to the lady of the American consul for Valparaiso. Correspondence in relation to the resentment of an indignity offered by the	6	16	1
British vessels between the Atlantic and Pacific ports of the United States, and the granting of American registers to British-built vessels purchased by citizens of the United States; also to an increase of duty on British produce or manufactures. Correspondence with the British minister relative to the trade in	10	36	1

	Vol.	No.	Page.
British government for slaves deported in violation of the treaty of September 3, 1783. Report of claims of American citizens against the - - -	10	46	1
British ships of war. Correspondence in relation to the searching of American vessels by - -	14	66	1
British and French possessions in North America. Extract of a letter from Mr. Everett, United States minister at London, to Mr. Webster, Secretary of State of the United States, in relation to the boundary line between the - - -	14	71	1
Bronno Bronski, in relation to an improved variety of silk-worms which he desires to have introduced into the United States. Memorial of Count de -	13	53	1
Bureau of Construction, &c., relative to contracts with Mr. R. L. Stevens for the construction of a war steamer, shot and shell-proof. Report of the chief of the - - - - - - -	1	1	446
Bureau of Construction, Equipment, and Repairs. Report and detailed estimates of the - - -	1	1	460
Bureau of Navy Yards and Docks. Report and detailed estimates of the - - - - -	1	1	554
Bureau of Ordnance and Hydrography. Report and detailed estimates of the - - - - -	1	1	548
Bureau of Provisions and Clothing. Report and detailed estimates of the - - - - -	1	1	706
Bureau of Medicine and Surgery. Report and detailed estimates of the - - - - -	1	1	743
Bureau of Yards and Docks. Abstract of offers for furnishing articles coming under the cognizance, under act of 3d March, 1843, of the - - -	1	1	664
Bureaus of the War Department during the fiscal year ending 30th June, 1849. Statement of contingent expenses of the several offices and - -	6	9	1

C.

California and New Mexico. Message from the President of the United States communicating information and correspondence in relation to - - -	9	18	1
California. Copy of the constitution of - - -	6	28	1
California, &c., accompanied by a report from Gilbert Rodman, special agent. Report of the Secretary of the Treasury, with correspondence, relating to the security and collection of the revenue in - -	14	82	1
California; and also in relation to the condition of civil affairs in Oregon. Message of the President of the United States, with a report of the Secretary of State, communicating further information in relation to the formation of a State government in -	13	52	1

	Vol.	No.	Page.
California and Oregon. Reports of Generals Smith and Riley, Lieutenants Talbot and Ord, Mr. Tyson, and Professor Frazer, in relation to the geology and topography of - - - - -	10	47	1
Census board, of its operations since it was constructed. Report of the - - - - - -	1	1	851
Census board, in answer to a resolution of the Senate of March 18, 1850, in relation to contracts for paper, &c. Report of the - - - - -	10	38	1
Cherokee Indians. (See *Indians.*)			
Chief of the Bureau of Construction, &c. (See *Bureau.*)			
Chief Engineer. (See *Engineer.*)			
China, under the act to carry into effect certain provisions of the treaties between the United States and China, and the Ottoman Porte. Report of the Commissioner to - - - - - -	14	72	2
Choctaw certificates. (See *Land.*)			
Clerks. (See *Executive departments.*)			
Coast at the mouth of the Rio Grande. Report of Lieut. Webster of a survey of the gulf - - - -	14	65	1
Coast survey, showing the progress of that work during the year ending November, 1849. Report of the superintendent of the - - - - -	5	5	1
Commerce and navigation of the United States for the year ending 30th June, 1849. Report of the Register of the Treasury, of the - - - -	5	3	1
Commerce of the lakes. (See *Lakes.*)			
Commissary General of the army for 1849. Annual report of the - - - - - - -	1	1	204
Commissary General of Subsistence during the year 1849. Report of contracts by the - - - -	6	26	37
Commissioner of Indian Affairs. Annual report of the	2	1	937
Commissioner of Pensions. Annual report of the -	2	1	1177
Commissioner of the General Land Office on the operations of that office during the year 1849. Report of the - - - - - - - -	2	1	17
Commissioner to run and mark the boundary between the United States and Mexico, parts 1 and 2. Correspondence relative to the operations of the -	10	34	1
Commissioner of the General Land Office in relation to the public lands in the Milwaukie land district. Report of the - - - - - -	10	45	1
Commissioner of the General Land Office relative to the land claimants of the land surrounding the Hot Springs of Arkansas. Report of the - -	14	70	1
Comptroller and Second Auditor of the Treasury, with a statement of the claims of the Cherokee nation of Indians, according to the principles established by the treaty of August, 1846. Report of the Second	6	6	1

	Vol.	No.	Page.
Constitution adopted by the inhabitants of New Mexico, with a digest of the votes for and against it; also, a letter to the late President Taylor from Manuel Alvarez. Copy of the - - - - -	14	74	1
Consul at Valparaiso. Correspondence in relation to the resentment of an indignity offered at Lima by the British chargé for Chili, to the lady of the American - - - - - - -	6	16	1
Contingent expenses. (See *Expenditures.*)			
Contracts authorized by the Treasury Department, &c., in 1849. Statement of - - - - -	10	31	1
Contracts under the cognizance of the Bureau of Construction, Equipment and Repair, from December 4, 1848, to November 14, 1849. List of -	1	1	470
Contracts made by the Bureau of Ordnance and Hydrography, for the year ending 30th June, 1849. Statement of - - - - - -	1	1	553
Contracts made and received by the Bureau of Yards and Docks, since November 4, 1848. List of -	1	1	580
Contract for furnishing annual supplies coming under the cognizance of the Bureau of Yards and docks, under act of March 3, 1843. Abstract of offers to	1	1	664
Contracts with R. L. Stevens for the construction of a war steamer to be shot and shell-proof. Report of the Chief of the Bureau of Construction, &., in relation to the - - - - - - -	1	1	446
Contract for furnishing navy supplies, transportation of stores, &c. Abstracts of proposals to - -	1	1	714
Contracts made by the Bureau of Provisions and Clothing for supplies for the navy during the fiscal year ending June 30, 1850. Statement of - -	1	1	736
Contracts made under the authority of the War Department during the year ending June 30, 1849. Statements by the Quartermaster, Commissary, and Surgeon Generals, and Colonels of Engineers, Topographical Engineers, and Ordnance - -	6	26	3 37 41 47 49 51
Courts of admiralty against foreign vessels entering the ports of the United States. Correspondence relative to suits instituted in - - -	14	78	1
Cuba, or some of the provinces of Mexico. Proclamation of the President of the United States, and correspondence in relation to an armed expedition for the invasion of - - - -	1	1	17
Cuba. Correspondence of the several heads of departments, in relation to alleged revolutionary movements in - - - - - - -	13	57	1
Cumberland dam. Report and estimate of Lieutenant Colonel Long, in relation to the repairs of the -	6	14	1

	Vol.	No.	Page.
D.			
Deaths in the United States squadron on the coast of Africa, and the annual cost of that squadron. Statement of the number of - - - -	10	40	1
Defences. (See *Frontier*.)			
Denmark. Correspondence with the Danish legation, in relation to fitting out, in New York, the American steamer "the United States," with intent, as alleged, to be employed in the service of the central government of Germany, in its war against -	1	1	49
Disbursements of the appropriations for the service of the State Department, including foreign missions, during the year 1849. Statement of the - -	10	30	1
Disbursements made for the benefit of the Indians. Statements of - - - - - - - -	10	41	1
Dismissions. (See *Navy*.)			
District of Columbia. Report of the annual expenses, for the last ten years, of the judiciary of the - -	13	54	1
Duty on British produce or manufactures. Correspondence with the British minister in relation to an increase of - - - - - - -	10	36	1
E.			
Electro-magnetic power as a mechanical agent for the purposes of navigation and locomotion. Report of Professor Charles G. Page, relative to his experiments for testing the capacity, &c., of the -	1	1	445
Electro-magnetic power as a mechanical agent for the purposes of navigation and locomotion. Report of Charles G. Page, relative to - - - -	13	61	1
El Paso, from Fort Smith to Santa Fe, by Captain Marcy; of an expedition into the Navajo country, by Lieutenant Simpson; and of an expedition on the western frontier of Texas. Reconnaissances of routes, by Brevet Lieutenant Colonel Johnson, and others, from San Antonio to - - - - -	14	64	1
Engineers, with a copy of P. T. Tyson's report on the geology of California. Report of the Bureau of Topographical - - - - - -	10	47	3
Engineers, in relation to the commerce of the lakes, American tonnage engaged, and the number of seamen employed thereon, &c. Report of the Bureau of Topographical - - - - -	10	48	1
Engineer of the army, for 1849. Annual report of the Chief - - - - - - - -	6 1	26 1	47 200
Engineers, with estimates, for 1849. Annual report of the Colonel of the Corps of Topographical -	6 1	26 1	49 294

	Vol.	No.	Page.
Espy's report in relation to meteorological observations and "rules for mariners." Professor - -	11 12	39	1
Estimates for surveys for frontier defences, military and geographical, northern and northwestern lakes, and the improvement of the habor at Mobile -	1	1	300
Estimates for improvement of rivers and harbors - -	1	1	300
Estimates for construction, repairs, &c., of light houses	1	1	300
Estimates and plans for improving the entrances from Lake Michigan into Maskegon lake, Black and Grand rivers. Report of Bureau of Topographical Engineers, of - - - - -	6	20	1
Estimates for the office of Secretary of the Navy; south west executive building; Bureau of Construction, Equipment, and Repair; Bureau of Ordnance and Hydrography; Bureau of Navy-yards and Docks; Bureau of Provision and Clothing; and Bureau of Medicine and Surgery. Aggregate of - -	1	1	453
Estimates for the office of Secretary of the Navy, and the several bureaus of the Navy Department, for the fiscal year ending June 30, 1851. General -	1	1	455
Estimate for the expenses of the southwest executive building for the fiscal year 1850–'51 - -	1	1	455
Estimate for the support of the navy for the fiscal year ending 30th June, 1851. General - -	1	1	456
Estimate for the support of the marine corps for the fiscal year ending 30th June, 1851. General - -	1	1	457
Estimates for the office of the Secretary of the Navy for the fiscal year ending 30th June, 1851. Detailed	1	1	458
Estimate for the pay of commission and warrant officers of the navy, including the engineer corps, (not on duty,) for the fiscal year ending 30th June, 1851	1	1	458
Estimate for the improvement and repair of buildings and grounds of the naval school at Annapolis for the fiscal year ending 30th June, 1851 - -	1	1	459
Estimate for the transportation of the United States mail, under act of 3d August, 1848, for the fiscal year ending 30th June, 1851 - - - - -	1	1	459
Estimate for the Nautical Almanac for the fiscal year of 1850–'51, under act of 3d March, 1849 - -	1	1	459
Estimate for the expenses of the Bureau of Construction, Equipment, and Repairs, for the fiscal year ending June 30, 1851 - - - - -	1	1	463
Estimate for the pay of commission, warrant, and petty officers and seamen, including engineer corps, &c., for the fiscal year ending 30th June, 1851 -	1	1	463
Estimate for increase, repairs, armament, and equipment of the navy, and for wear and tear of vessels in commission, including fuel for steamers and the purchase of hemp for the navy, for the fiscal year ending 30th June, 1851 - - - - -	1	1	464

	Vol.	No.	Page.
Estimate for the expenditures under the head of "enumerated contingent," for the fiscal year ending June 30, 1851	1	1	464
Estimate for the expenses of the Bureau of Ordnance and Hydrography for the fiscal year ending 30th June, 1851	1	1	549
Estimate for pay of officers on ordnance duty for the year ending 30th Juue, 1851	1	1	549
Estimate of ordnance and ordnance stores, &c., required for the general service of the navy for the year ending 30th June, 1851	1	1	550
Estimate for the support of the Hydrographical Office and National Observatory for the year ending June 30, 1851	1	1	551
Estimate for the support of the Bureau of Yards and Docks for the year ending 30th June, 1851	1	1	568
Estimate for pay of officers attached to the recruiting stations for the year ending 30th June, 1851	1	1	569
Estimate for pay of officers and others at navy-yards and stations for the year ending 30th June, 1851	1	1	569
Estimate for the construction, extension, and completion of works at the several navy-yards, and for the necessary current repairs at the same, for the fiscal year ending 30th June, 1851	1	1	576
Estimate for the Bureau of Yards and Docks for the year ending 30th June, 1851. Statement showing the several sums which make up the amounts of the 1st and 2d items in the general	1	1	577
Estimate for hospitals and magazines	1	1	578
Estimate for the completion of the stone dry dock at New York, and for the completion of the floating dry-docks to be built at Kittery, Philadelphia, and Pensacola navy-yards	1	1	578
Estimate from the Bureau of Yards and Docks for the year ending 30th June, 1851, in addition to the balances remaining unexpended 1st July, 1850. General	1	1	579
Estimate for that portion of the United States naval service coming under the cognizance of the Bureau of Provisions and Clothing during the year ending 30th June, 1851	1	1	709
Estimate of the expenses of the Bureau of Provisions and Clothing for the fiscal year ending 30th June, 1851	1	1	709
Estimates for its support during the fiscal year ending 30th June, 1851, &c. Report of the Bureau of Medicine and Surgery, with	1	1	743
Estimates for pay and subsistence of officers, pay of non-commissioned officers, musicians, and privates, of the marine corps, and for undrawn rations and clothing, for the year ending 30th June, 1851, including three months' extra pay, under resolution of 10th August, 1848	1	1	756

	Vol.	No.	Page.
Estimates of the expenses of the Quartermaster's department of the marine corps for the year ending 30th June, 1851	1	1	759
Estimates for the mail service, &c., during the year ending 30th June, 1850	1	1	776
Estimate of appropriations for the office of the Commissioner of the General Land Office for the fiscal year ending 30th June, 1851	2	1	65
Estimate of appropriations for the surveying department for the fiscal year ending 30th June, 1851	2	1	66
Estimate by Lieutenant Colonel Long for the repair of the Cumberland dam	6	14	1
Expenditures on account of national armories, and the number of arms, &c., during the year ending 30th June, 1849. Statement of	6	27	8
Expenditures on account of the service of the State Department in 1849. Statement of	10	30	1
Expenditures from the marine hospital fund for the relief of sick and disabled seamen. Statement of	10	31	8
Expenditures, under the head of contingent expenses, as settled and allowed at the Fourth Auditor's office of the Treasury Department. Statement of	1	1	764
Expenditures for contingencies of the various offices and bureaus of the War Department during the fiscal year ending 30th June, 1849. Statements of	6	9	1
Expenditures for the service of the War Department during the fiscal year ending June 30, 1849. Statement of appropriations and	6	10	1
Expenses of the judiciary of the District of Columbia. Report in relation to the	13	54	1

F.

Finances. Annual report of the Secretary of the Treasury on the state of the	4	2	1
First Assistant Postmaster General. (See *Postmaster General.)*			
Florida. Instructions (17th September, 1849) of the Secretaries of War and Interior to Brigadier General Twiggs and S. Spencer, Sub-Indian agent, respecting the removal of the Seminole Indians remaining in	2	1	961
Florida in 1849, (part 1.) Report of military operations in	1	1	116
Florida, during the past year, the area occupied by them, their removal, &c. Correspondence in relation to hostilities committed by the Seminole Indians in	13	49	3
Foreign vessels. (See *Vessels.)*			
Fortifications, and military establishments connected therewith, in 1849. Condition, repairs, &c., of	1	1	209

	Vol.	No.	Page.
Fort Smith, in Arkansas, to Santa Fe, in New Mexico. Report and map, by Lieutenant Simpson, of the route from - - - - - - -	6	12	1
Fort Smith to Santa Fe. Report of Captain Marcy's reconnaissance of the route from - - -	14	64	1
Fourth Auditor. (See *Auditor.*)			
Frauds upon the revenue since the act of 1846. Statement of measures adopted to prevent - -	14	79	1
Franklin, relative to the expedition to the Arctic regions under the command of her husband. Correspondence with the lady of Sir John - - -	6	8	1
Frontier defences. Estimates for inland and Atlantic	1	1	300
G.			
Garcia, from New Orleans, by the Spanish consul at that port. Correspondence relating to the abduction of Rey, *alias* - - - - - - -	6	13	1
Geological and mineralogical survey of the United States mineral lands in Michigan, under act of March 1, 1847, by Charles T. Jackson, United States geologist, for the survey of the United States mineral lands in Michigan. Report of the - -	3	1	371
Geological specimens collected in Messrs. Hubbard and Ives's districts of public surveys in 1846. Catalogue of - - - - - - -	3	1	913
Geology and topography of California and Oregon. Reports of Brevet Major General Smith and Brevet Brigadier General Riley, with accompanying reports of Mr. Tyson, Professor Fraser, and Lieutenants Talbot and Ord, in relation to the - -	10	47	1
German government, and to securing the services of naval officers of the United States in building up the German navy. Correspondence with the minister of the German Empire in relation to the construction of a war steamer at New York, destined, as alleged, for the service of the - - -	1	1	18
Great Britain and the United States in relation to the exchange of mails. Regulations adopted by -	1	1	803
Guano. Report respecting commercial privileges extended to citizens of the United States in relation to the trade in Peruvian - - - -	13	59	1
Guano. Despatch from Mr. Clay, chargé d'affaires at Lima, respecting Peruvian - - - -	14	80	1
Gurley, who was recently sent out by the government to obtain information in respect to Liberia. Report of the Rev. R. R. - - - - -	14	75	1
H.			
Hagner, in relation to the mode of manufacturing percussion powder and caps, small arms, &c., in France, Belgium, Holland, and England. Report of Brevet Major P. V. - - - - - -	1	1	374

	Vol.	No.	Page.
Harbors and rivers for the year ending 30th June, 1851. Estimates for the improvement of - - -	1	1	300
Hardcastle's map of the valley of Mexico. Report of the Secretary of War, communicating Lieutenants Smith and - - - - - -	6	11	1
Hot Springs of Arkansas. (See *Lands.*)			
Hungarian exiles. Correspondence with the Turkish government on the subject of the - -	14	81	1
Hungary during the recent war between that country and Austria. Correspondence with the agent employed to visit - - - - - - -	10.	43	1
Hughes's description of the march of a division of the United States army, under the command of General Wool, from San Antonio de Bexar, in Texas, to Saltillo, in Mexico. Captain - - -	10	32	5

I.

Indians remaining in Florida. Instructions of 17th September, 1849, of the Secretaries of War and Interior to Brigadier General Twiggs, and S. Spencer, Indian sub-agent, respecting the removal of the Seminole - - - - - - -	2	1	961
Indians and Indian affairs in that State. Report of 7th March, 1849, of R. S. Neighbors to Brigadier General Worth, commanding the troops in Texas, in relation to - - - - - -	2	1	963
Indians and Indian affairs in Texas. Captain Catlett's communication, 12th May, 1849, and report of Commissioner of Indian Affairs, 4th June, 1849, in relation to the - - - - -	2	1	965
Indians for a portion of their lands in Minnesota. Instructions to the commissioners, 25th August, 1849, appointed to negotiate with the Dacotah or Sioux - - - - - - -	2	1	990
Indian affairs in Oregon. Extract from a report of Governor Lane, 9th April, 1848, in relation to -	2	1	994
Indian affairs in New Mexico. Report, 1st October, 1849, of J. S. Calhoun, Indian agent at Santa Fe, in relation to - - - - - -	2	1	994
Indian agent at Salt Lake, California. Report of John Wilson - - - - - - -	2	1	1002
Indian affairs in Minnesota. Report of Governor Ramsey in relation to - - - - - -	2	1	1005
Indian Affairs. Annual report of the Commissioner of -	2	1	937
Indians. Treaty between the United States and the Navajoe tribe of - - - - - -	1	1	113
Indians. Statement of accounts of disbursements made for the benefit of the - - - - -	10	41	1
Indians of the United States on the frontier of Mexico. Translation of a letter from the Mexican minister to the Secretary of State, in relation to the wild -	10	44	1

	Vol.	No.	Page.
Indians in Florida during the past year, the area now occupied by them, their removal, &c. Correspondence relative to hostilities committed by the Seminole - - - - - - - -	13	49	1
Indians, for the year ending 30th September, 1848. Report of the Second Auditor of the Treasury in relation to the disbursement or application of moneys, goods, or effects for the benefit of the - -	5	4	1
Indians, according to the principles established by the treaty of August, 1846. Report of the Second Comptroller and Second Auditor of the Treasury, with a statement of the claims of the Cherokee nation of - - - - - - -	6	6	1
Interior, of the condition and operations of the Interior Department during the year 1849. Report of the Secretary of the - - - - -	2	1	1
Interior, with a statement from the Commissioner of the General Land Office, showing the amount of public land originally contained in each State, the number of acres granted to each State for objects of internal improvement, the number necessary to make the grants to each State equal to the maximum of the State receiving the greatest quantity, and the number necessary to make each grant equal in proportion to the areas of each of the several States. Report of the Secretary of the -	6	17	1
Interior, of rejected applications for pensions. Report of the Secretary of the - - - - -	6	22	1
Interior, relative to the printing for that department. Report of the Secretary of the - -	10	33	1
Interior, communicating information in relation to the operations of the commission appointed to run and mark the boundary between the United States and Mexico. Reports (parts 1 and 2) of the Secretary of the - - - - - - -	10	34	1
Interior, in relation to the public lands in the Milwaukie land district. Report of the Secretary of the -	10	45	1
Interior, in relation to the expense of the judiciary of the District of Columbia. Report of the Secretary of the - - - - - - -	13	54	1
Interior, showing the quantity of land sold, the amount of money received therefor, and the amount of incidental expenses thereon, in the years 1847, '48, and '49. Report of the Secretary of the - -	13	63	1
Interior, relative to the swamp and overflowed lands in Louisiana. Report of the Acting Secretary of the - - - - - - -	14	68	1
Interior, relative to the Hot Springs of Arkansas. Report of the Secretary of the - - - -	14	70	1

	Vol.	No.	Page.
Interior to General Twiggs, and S. Spencer, sub-Indian agent, dated 17th September, 1849, respecting the removal of the Seminole Indians remaining in Florida. Instructions of the Secretaries of War and - - - - - - -	2	1	961
J.			
Judiciary of the District of Columbia. Report of the annual expenses, for the last ten years, of the -	13	54	1
K.			
Kosciusko against Alexandre de Bodisco, the Russian minister. Report in relation to measures taken by the Secretary of State on the memorial of the great grandnephew and attorney of the heirs of General	13	50	1
L.			
Lakes, amount of American tonnage engaged, number of seamen employed thereon, &c. Report of the Topographical Bureau, in relation to the commerce of the - - - - - - -	10	48	1
Lake Michigan into Maskegon lake, Black river, and Grand river. Reports of plans and estimates for improving the entrances from - - - -	6	20	1
Lands in the Milwaukie land district. Report of the Commissioner of the General Land Office, in relation to the public - - - - -	10	45	1
Land sold, the amount of money received therefor, and the amount of incidental expenses thereon, in the years 1847, 1848, and 1849. Report of the quantity of - - - - - - -	13	63	1
Lands in Louisiana. Report of the Acting Secretary of the Interior relative to the swamp and overflowed	14	68	1
Lands surrounding the Hot springs in Arkansas. Report of the Secretary of the Interior in relation to the applications of private claimants to the - -	14	70	1
Land Office, of the operations of that office during the year 1849. Report of the Commissioner of the General - - - - - - -	2	1	17
Lands sold; of cash, Treasurer's receipts, treasury notes, stock, &c., received therefor; of incidental expenses thereon; and of payments into the treasury on account thereof, in the year 1848. Statement of the public - - - - - -	2	1	36
Lands sold; of cash, Treasurer's receipts, treasury notes, stock, &c., received therefor; of incidental expenses thereon; and of payments into the treasury on account thereof, during the first and second quarters of the year 1849. Statement of public			

	Vol.	No.	Page.
nds sold; of cash, Treasurer's receipts, treasury notes, stock, &c., received therefor; of incidental expenses thereon; and of payments into the treasury on account thereof, in the third quarter of the year 1849. Statement of public - - - -	2	1	47
nds in the States of Alabama, Mississippi, Louisiana, and Arkansas; the number of acres covered by such relinquishment, &c., so far as the returns to September 30, 1849, have been received at the General Land Office. Statement showing the number of Choctaw certificates relinquished to the United States for - - - - -	2	1	53
nds under the act of September 4, 1841, "to appropriate the proceeds of the sales of the public lands, and to grant pre-emption rights." Exhibit of State selections of - - - - - -	2	1	57
nd warrants returned, located for patents, during 1847, 1848, and 1st, 2d, and 3d quarters of 1839. Statement of military bounty - - - -	2	1	56
nd (exclusive of the 16th or school sections and postponed sales) advertised for sale in 1849; the quantities, the plats of surveys of which have been returned to the General Land Office; the quantities prepared for market not yet advertised; and the probable quantities which will be prepared in 1850. Exhibit of the quantities of public - -	2	1	58
nds advertised for sale since November 30, 1848, showing the quantity under proclamation, exclusive of school lands. Synopsis of the public -	2	1	59
nd States and Territories, the amount of land disposed of by sale and otherwise, and the amount unsold and undisposed of on the 30th September, 1849. Statement of the areas of the several - -	2	1	63
and claims made by the Commissioner of the General Land Office, and approved by the Secretary of the Treasury or Interior and Attorney General, under the act of 1846, "providing for the adjustment of all suspended pre emption land claims in the several States and Territories," and the act of 1848, to extend the said act. Abstract of adjudications of - - - - - -	2	1	68
Lands surveyed, &c., in Iowa and Wisconsin, in 1849. Annual report of the surveyor general of Iowa and Wisconsin of the - - - - - -	2	1	232
ands in Michigan. Report of C. T. Jackson, United States geologist, and assistants, of a survey of mineral - - - -	3	1	371
ands, with r[illegible] in the nor[illegible] rs 1845 an[illegible] Messrs. [illegible] Ives, of	3	1	803

	Vol.	No.	Page.
Lands originally contained in each State; the number of acres granted to each State for objects of internal improvement; the number necessary to make the grants to each State equal to the maximum of the State receiving the greatest quantity, and the number necessary to make each grant equal in proportion to the areas of each of the several States. Report of the Commissioner of the General Land Office, showing the amount of - - -	6	17	1
Liberia. Report of the Rev. R. R. Gurley, who was recently sent out by the government to obtain information in respect to - - - - - -	14	75	1
Light-houses. Construction, condition, repairs, &c., of	1	1	296
Light houses for the year ending 30th June, 1851. Estimates for - - - - - -	1	1	300
Long's plan and estimate for the repair of the Cumberland dam. Lieutenant Colonel - - -	6	14	1

M.

Mail routes, mail contractors, route agents, local agents, and mail messengers in the several sections on the 30th of June, 1849. Statement of the number of	1	1	802
Mail service in the years 1848 and 1849. Comparative statements of - - - - - -	1	1	775
Mail service for the year ending 30th of June, 1849. Tabular statement of - - - - - -	1	1	800
Mails between Great Britain and the United States. Regulations adopted in relation to the exchange of -	1	1	803
Mail service as in operation October 1, 1849. Statement of steamboat - - - - - -	1	1	842
Mail service as in operation October 1, 1849. Statement of railroad - - - - - - -	1	1	844
Mail between New York and New Orleans in the year 1849. Report of the Postmaster General respecting the alleged failures of the - - -	13	62	1
Mail in steam vessels between New York and Liverpool and Charleston and Havana. Report of the Postmaster General in relation to an alleged non-compliance of contract for carrying the - - -	14	77	1
Manufactures for the year 1849. Report of the Commissioner of Patents in relation to arts and - - *(See table of contents of the above, at page 2 of the same.)*	7	15	1
Map of the valley of Mexico. (See *Mexico.*)			
Marcy, of a route from Fort Smith to Santa Fe. Reconnaissance by Captain - - - - -	14	64	1
Marine hospital fund for the relief of sick and disabled seamen. Statement of expenditures from the -	10	31	31
Marine corps, and detailed estimates for the paymaster and the quartermaster of the corps. Report of the commandant of the - - - - -	1	1	751

	Vol.	No.	Page.
Mariners." Professor Espy's report of "Rules for -	12	39	1
Maskegon, lake. (See *Lake.*)			
Medicine and Surgery, with estimates for its support during the fiscal year ending June 30, 1851, and a statement of the number and grades of medical officers required for duty during the same period, at home stations and afloat. Report of the Bureau of - - - - - - - - -	1	1	743
Messages of the President. (See *President.*)			
Meteorology, &c. Report of the Commissioner of Patents, in relation to agricultural - - - - -	8	15	1
Meteorological observations, by Professor Espy, part 1. Report of - - - - - - -	11	39	1
Meteorological observations, by Professor Espy, part 2. Report of - - - - - - -	12	39	1
Mexican minister, to Mr. Clayton, Secretary of State, in relation to the wild Indians of the United States on the frontier of Mexico. Translation of a letter from Mr. De La Rosa - - - - -	10	44	1
Mexico. Operations of the commission to run and mark the boundary between the United States and -	10	34	1
Mexico. Proclamation of the President of the United States, with correspondence, in relation to an armed expedition alleged to be for the invasion of Cuba, or some of the provinces of - -	1	1	17
Mexico in relation to the character and validity of the Protocol of the conferences previous to the ratification of the treaty at Queretaro, of May 26, 1848. Correspondence with the legation of - -	1	1	69
Mexico, from surveys by Lieutenants Smith and Hardcastle. Report of the Secretary of War, communicating a map of the valley of - - -	6	11	1
Michigan. Lake. (See *Lake.*)			
Michigan, by C. T. Jackson, United States Geologist, and his assistants. Report of a survey of mineral lands in - - - - - -	3	1	371
Michigan, in the years 1845 and 1846. Reports, by Messrs. Burt, Hubbard, Houghton, Higgins, and Ives, of linear surveys with reference to mines and minerals in the northern peninsula of -	3	1	803
Military Academy. (See *Academy.*)			
Military bounty-land warrants. (See *Land.*)			
Military roads. (See *Roads.*)			
Militia, their arms, accoutrements, and ammunition. Abstract of the returns of the - - -	6	25	1
Militia of the several States for the year 1848, under act of 1808. Statement of the apportionment of arms to the - - - - - - -	1	1	423
Milwaukie land district. (See *Lands.*)			
Mines and minerals in the northern peninsula of Michigan, in 1845 and 1846. Reports of linear surveys with reference to - - - - -	3	1	802
(See index to the above, at page 803 of same.)			

	Vol.	No.	Page.
Mineral lands. (See *Lands.*)			
Minnesota, by Brevet Captain Pope. Report of an exploration of the Territory of - - - -	10	42	1
Mint, for the year 1849. Report of the director of the -	6	21	1
N.			
Nautical Almanac, provided for under act of 3d March, 1849. Report of Lieutenant C. H. Davis relative to the - - - - - - -	1	1	443
Navajo country. Report of Lieutenant Simpson's expedition into the - - - - - -	14	64	1
Naval officers. Report in relation to allowances to -	13	51	1
Naval officers of the United States to aid in building up the German navy, &c. Correspondence in relation to securing to the Germanic confederation the services of - - - - - -	1	1	118
Naval stations at home and abroad, submitted July 1, 1849. Statement of the value of provisions, clothing, and small stores at - - - -	1	1	711
Naval stations; and also condemned and sold at auction at naval stations at home and abroad during the year ending June 30, 1849. Statement showing the cost of provisions, clothing, and small stores condemned on board the various national vessels at foreign - - - - - -	1	1	713
Navigation and commerce of the United States for the year ending June 30, 1849. Report of the Register of the Treasury of the - - - -	5	3	1
Navy, of the condition and operations of the Navy Department of the public service during the year 1849. Report of the Secretary of the - -	1	1	425
Navy, of transfers of appropriations for the naval service during the year ending 30th June, 1849. Report of the Secretary of the - - - - -	6	7	1
Navy, showing the annual number of deaths in the United States squadron on the coast of Africa, and the annual cost of that squadron. Report of the Secretary of the - - - - - -	10	40	1
Navy, in relation to allowances to navy officers. Report of the Secretary of the - - - -	13	51	1
Navy, transmitting a copy of the report of Prof. Charles G. Page on electro-magnetic power as a mechanical agent for the purposes of navigation and locomotion. Report of the Secretary of the - -	13	61	1
Navy pensioners. (See *Pensioners.*)			
Navy. List of deaths, resignations, and dismissions in the - - - - - - -	1	1	448
Navy-yards, July 1, 1848, and of the articles received and expended from June 30, 1848, to June 30, 1849; also of those remaining on hand July 1, 1849, under the direction of the Bureau of Con-			

	Vol.	No.	Page.
struction, Equipment, and Repairs. Statement of the cost or estimated value of stores on hand at the several - - - - - - - -	1	1	468
Navy-yards, for building, repairing, or equipping vessels of the navy, or in receiving or securing stores and materials for those purposes. Statement of the number of days' labor, and its cost, from July 1, 1848, to July 1, 1849, for the respective - -	1	1	469
Navy-yards, from 4th December, 1848, to 14th November, 1849. Abstract of offers to furnish naval supplies at the several - - - - -	1	1	514
Navy-yards, July 1, 1848, of articles received and expended from June 30, 1848, to June 30, 1849, and of those remaining on hand July 1, 1849, under the direction of the Bureau of Ordnance and Hydrography. Statement of cost or estimated value of stores on hand at the several - -	1	1	550
Navy-yards, chargeable to the Bureau of Ordnance and Hydrography. Statement of the number of days' labor, and cost thereof, from July 1, 1848, to June 30, 1849, at the respective - - - -	1	1	551
Navy Department, as settled and allowed at the Fourth Auditor's office for the year ending 30th September, 1849. Abstract of contingent expenses of the	1	1	764
Navy Department, in relation to the amount of prize-money paid into the treasury under the act of March 3, 1849. Correspondence of the - -	10	35	1
Navy Department and officers of the navy, and the governor of Mississippi, in relation to the assemblage, &c., of persons on Round island, coast of Mississippi, during the summer of 1849. Correspondence between the - - - - -	13	55	1
Navy, communicating to Mr. Levy, chairman of the Committee on Naval Affairs, the report of Professor Espy relating to rules for mariners, part 2. Report of the Secretary of the - - - -	12	39	1
New Mexico in 1849, (part 1.) Report of civil and military operations in - - - - -	1	1	105
New Mexico, (parts 1 and 2.) Report of the Secretary of War in relation to the formation of a State government in - - - - - - -	13	60	1
New Mexico. Message from the President of the United States relative to the claim of Texas to jurisdiction over part of. - - - - - -	14	67	1
New Mexico, together with a digest of the votes for and against it; also a letter to the late President of the United States from Manuel Alvarez. Constitution adopted by the inhabitants of - -	14	74	1
New Mexico, setting forth sundry grievances, and calling upon Congress for their correction. Communication of R. H. Weightman accompanying a memorial of the legislature of - - - -	14	76	1

	Vol.	No.	Page.
New Mexico and California. Message from the President of the United States communicating information, with extensive correspondence, in relation to -	9	18	1
O.			
Ocean steamers. (See *Steam vessels.*)			
Officers of the navy. Report in relation to allowances to	13	51	1
Ordnance. Annual report of the Colonel of - -	1	1	255
Ordnance stores. (See *Navy yards.*)	6	26	51
Ordnance, in relation to the mode of manufacturing percussion caps, small arms, &c , in France, Belgium, Holland, and England. Report of P. V. Hagner, Brevet Major and First Lieutenant of -	1	1	375
Oregon. Correspondence embracing further information in relation to the formation of a State government in California; and also in relation to the condition of civil affairs in - - - - -	13	52	1
Overflowed lands. (See *Lands.*)			
P.			
Page, on electro-magnetic power as a mechanical agent for the purposes of navigation and locomotion. Report of Professor Charles G. - - -	13	61	1
Patents in relation to arts and manufactures for the year 1849. Annual report of Commissioner of . -	7	15	1
Patents in relation to agricultural statistics, American agriculture, agricultural meteorology, breadstuffs, crops, &c. Report of the Commissioner of - -	8	15	1
Paymaster General of the army, for 1849. Annual report of the - - - - - - -	1	1	198
Pensions, showing the operations of that office during the year 1849. Annual report of the Commissioner of - - - - - - -	2	1	1177
Pensioners in the different States under the several pension acts of 1818, 1828, 1832, 1836, 1838, 1843, 1844, February 2, July 21 and 29, 1848. Statement of the number of - - - - - -	2	1	1180
Pensioners added to the rolls of the several States since the last annual report. Statement of the number of - - - - - -	2	1	1182
Pensioners whose deaths have been reported since the last annual return. Statement of the number of -	2	1	1184
Pensioners who have been paid in the first and second quarters of 1849. Statement of the number of -	2	1	1186
Pension agents at the dates of their last returns, on account of invalid, widows' and revolutionary pensions. Statement of balances in the hands of the several - - - - - - -	2	1	1188
Pensioners complete to November 7, 1849. Alphabetical list of invalid navy - - - -	2	1	1193

	Vol.	No.	Page.
Pensions during the year 1849. Report of rejected appropriations for - - - - -	6	22	1
Pensioners complete to November 7, 1849. Alphabetical list of persons restored to the roll of privateer -	2	1	1204
Pensions under the act of August 11, 1848. Alphabetical list of widows who are now drawing - -	2	1	1205
Pensioned under the act of August 11, 1848. Alphabetical list of the orphan children of officers, seamen, and marines who have been - - - - -	2	1	1215
Peruvian indemnity under the convention of March, 1841. Report in relation to the payment of - -	13	58	1
Peruvian guano. Report respecting the commercial privileges of United States citizens in relation to the trade in - - - - - - - -	13	59	1
Peruvian guano. Despatch from J. R. Clay, chargé d'affaires at Lima, respecting - - - -	14	80	1
Pope's exploration of the Territory of Minnesota. Report of Captain - - - - - -	10	42	1
Port of Brazos de St. Jago. Report of the Secretary of the Treasury relative to the commerce of the -	14	69	1
Ports of the United States. Correspondence relating to suits instituted in courts of admiralty against foreign vessels entering the - - - -	14	78	1
Postmaster General of the condition and operations of the Post Office Department during the year 1849. Report of the - - - - - - -	1	1	773
Postmaster General in relation to the mail service for the year ending June 30, 1849. Report of the First Assistant - - - - - - - -	1	1	791
Postmaster General respecting the failure of the mail between New York and New Orleans in the year 1849 Report of the - - - - -	13	62	1
Postmaster General in relation to an alleged non-compliance of contract concerning steam vessels carrying the United States mail. Report of the - -	14	77	1
Postmasters by the Postmaster General, which, by law, only belong to the President. Report in relation to the appointment of - - -	10	37	1
Post Office Departments of Great Britain and the United States in relation to the exchange of mails. Regulations agreed upon between the - - -	1	1	803
President of the United States, with the accompanying documents, in three parts, on the state of the Union. Message from the - - - - - -	1	1	1
President of the United States, communicating copies of a correspondence with the lady of Sir John Franklin relative to the expedition to the Arctic regions under the command of her husband. Message from the - - - - - - -	6	8	1
President of the United States, communicating information in relation to the abduction of Rey, alias Garcia, from New Orleans. Message from the -	6	13	1

	Vol.	No.	Page.
President of the United States, communicating information in relation to California and New Mexico. Message from the	9	18	1
President of the United States, communicating the report of the director of the mint for the year 1849. Message from the	6	21	1
President of the United States, with copies of the correspondence in relation to the boundary of Texas. Message from the	6	24	1
President of the United States, communicating a copy of the constitution of California. Message from the	6	28	1
President of the United States, showing the amount of prize money paid into the treasury under the 8th section of the act of March 3, 1849. Message from the	10	35	1
President of the United States, communicating copies of the correspondence with the British minister relative to the trade in British vessels between the Atlantic and Pacific ports of the United States, and the granting of American registers to British-built vessels purchased by citizens of the United States; also to an increase of duty on British produce or manufactures. Message from the	10	36	1
President of the United States, in relation to the appointment of postmasters. Message from the	10	37	1
President of the United States, communicating a translation of a note from the Mexican minister in relation to the wild Indians of the United States on the frontier of Mexico. Message from the	10	44	1
President of the United States, transmitting a memorial of Count de Bronno Bronski, in relation to an improved breed of silk-worms, which he desires to have introduced into the United States. Message from the	13	53	1
President of the United States, communicating information in relation to military orders issued to the United States officers at Santa Fe, and correspondence between those officers and the War Department in relation to the claims of Texas to jurisdiction over that country. Message from the	13	56	1
President of the United States, relative to the payment of the Peruvian indemnity. Message from the	13	58	1
President of the United States, in answer to a resolution calling for information in relation to the formation of a State government in New Mexico, (parts 1 and 2.) Message from the	13	60	1
President of the United States, communicating the report of Lieutenant Webster of a survey of the gulf coast at the mouth of the Rio Grande. Message from the	14	65	1

	Vol.	No.	Page.
President of the United States, relative to the searching of American vessels by British ships of war. Message from the - - - - - -	14	66	1
President of the United States, relative to the claim of Texas to jurisdiction over part of New Mexico. Message from the - - - - - -	14	67	1
President of the United States, relative to the commerce of the port of Brazos de St. Iago. Message from the - - - - - -	14	69	1
President of the United States, communicating the report of the commissioner to China, made in pursuance of the provisions of the act to carry into effect certain provisions of the treaties between the United States and China and the Ottoman Porte. Message from the - - - - - -	14.	72	1
President of the United States, transmitting a copy of the constitution adopted by the inhabitants of New Mexico, together with a digest of the votes for and against it; also a letter to the late President of the United States. Message from the - -	14	74	1
President of the United States, communicating a copy of the correspondence between the Department of State and the Turkish government, on the subject of the Hungarian exiles. Message from the -	14	81	1
President of the United States, communicating further information in relation to the formation of a State government in California, and also in relation to the condition of civil affairs in Oregon. Message from the - - - - - - -	13	52	1
President of the United States, communicating information relative to hostilities committed by the Seminole Indians in Florida during the past year, their removal, &c. Message from the - - -	13	49	1
President of the United States, in relation to alleged revolutionary movements in Cuba. Message from the	13	57	1
President of the United States, communicating copies of correspondence with the agent employed to visit Hungary during the recent war between that country and Austria. Message from the - -	10	43	1
President of the United States, with correspondence in relation to the assemblage, dispersion, &c., of persons on Round island, coast of Mississippi. Message from the - - - - -	13	55	1
Printing for the Interior Department. Report in relation to the - - - - - - -	10	33	1
Privateer pensions. (See *Pensions*.)			
Prize money paid into the treasury under the 8th section of the act of March 3, 1849. Statement of the amount of - - - - - - -	10	35	1

	Vol.	No.	Page.
Proclamation of the President of the United States, in relation to an armed expedition for the invasion of Cuba, or some of the provinces of Mexico -	1	1	17
Proposals. (See *Contracts.*)			

Q.

Quartermaster General of the army for the year 1849. Annual report of the - - - - -	1	1	192
	6	26	3

R.

Railroad mail service. (See *Mail Service.*)			
Reconnaissances of Lieutenant Colonel Johnson, and Lieutenants Smith, Bryan, and Michlor, of routes from San Antonio to El Paso; of the western frontier of Texas; from Fort Smith to Santa Fe; and of an expedition to the Navajo country. Reports of	14	64	1
Register of the Treasury, of the commerce and navigation of the States for the year ending 30th June, 1849. Report of the - - - - -	5	3	1
Resignations. (See *Navy.*)			
Revenue since the passage of the act of 1846. Statement of the measures adopted to prevent frauds upon the - - - - - - -	14	79	1
Revenue in California, &c. Report of the Secretary of the Treasury, in relation to the security and collection of the - - - - - -	14	82	1
Rey, alias Garcia, from New Orleans, by the Spanish consul at that port. Correspondence in relation to the abduction of - - - - - (*See list of correspondence at page 2 of the above.*)	6	13	1
Rio Grande. Report of the operations of the army on the	14	73	1
Rivers and harbors for the year ending June 30, 1851. Estimates for the improvement of - -	1	1	300
River. Survey, by Lieutenant Smith, of the Savannah	6	19	1
River, and Grand river. Report of topographical engineers, with plans and estimates for improving the entrance from Lake Michigan into Maskegon lake, Black - - - - - -	6	20	1
Roads, from the valley of the Mississippi to the Pacific ocean. Report in relation to surveys of routes for military - - - - - - -	1	1	154
Road from Fort Smith, Arkansas, to Santa Fe, in New Mexico. Report and map by Lieutenant Simpson of a - - - - - - -	6	12	1
Round island, on the coast of Mississippi, in the summer of 1849. Correspondence in relation to the assemblage, &c., of persons on - - -	13	55	1
Russian minister. (See *Bodisco.*)			

S.

	Vol.	No.	Page.
Saltillo. (See *San Antonio de Baxar.*)			
San Antonio de Baxar, in Texas, to Saltillo, in Mexico. Memoir of Captain Hughes, in relation to the march of the division of the United States army under the command of General Wool, from -	10	32	5
San Antonio to El Paso, and of the western frontier of Texas, and from Fort Smith to Santa Fe, and of an expedition into the Navajo country. Reconnaissances by Brevet Lieutenant Colonel Johnson and others, of routes from - - - -	14	64	1
Santa Fe, New Mexico, made by Lieutenant Simpson. Report and map of the route from Fort Smith, Arkansas, to - - - - - - -	6	12	1
Santa Fe, and correspondence in relation to the claims of Texas over that country. Report in relation to military orders issued to the United States officers at	13	56	1
Santa Fe. Report of Captain Marcy's reconnaissance of the route from Fort Smith to - - -	14	64	1
Savannah river. (See *River.*)			
Scott, on the state and condition of the army in 1849. Report of Major General - - - - -	1	1	99
Seamen. Statement of expenditures from the marine hospital fund for the relief of sick and disabled -	10	31	31
Seamen employed on the lakes. Report of the Bureau of Topographical Engineers, in relation to the commerce, tonnage, and number of - -	10	48	1
Searching of American vessels by British ships of war. Correspondence relative to the - - -	14	66	1
Second Auditor of the Treasury. (See *Auditor.*)			
Seminole Indians. (See *Indians.*)			
Ships of war. (See *British ships of war.*)			
Silkworms he desires to have introduced into the United States. Memorial of Count de Bronno Bronski, in relation to an improved variety of - -	13	53	1
Simpson, with a map, of the route from Fort Smith, Arkansas, to Santa Fe, New Mexico. Report of Lieutenant - - - - - -	6	12	1
Slaves deported in violation of the treaty of September 3, 1793. Report in relation to claims of American citizens against the British government for -	10	46	1
Smith's survey and examination of the Savannah river. Lieutenant - - - - - -	6	19	1
Smith and Hardcastle. Report of the Secretary of War, communicating a map of the valley of Mexico from surveys by Lieutenants - - - -	6	11	1
Spanish consul at the port of New Orleans. Correspondence in relation to the abduction of Rey, *alias* Garcia, by the - - - - - -	6	13	1
(See list of papers embraced in the above, at page 2 of the same.)			

	Vol.	No.	Page.
Squadron on the coast of Africa, and the annual cost of that squadron. Report of the number of deaths in the United States - - - - -	10	40	1
Squadrons on foreign stations during the fiscal year ending 30th June, 1849. Statement showing the value, &c., of shipments made by the Bureau of Provisions and Clothing to the respective -	1	1	712
State and the minister of the German Empire, in relation to the construction of a war steamer at New York, alleged to be destined for the German service. Correspondence between the Department of -	1	1	18
State and the minister of Mexico, in relation to the protocol of the conferences held previous to the treaty of peace at Queretaro, between the United States and Mexico. Correspondence between the Secretary of - - - - - - - -	1	1	69
State, with the correspondence in relation to the resentment of the indignity offered by the British chargé d'affaires for Chili, to the lady of the United States consul at Valparaiso. Report of the Secretary of - - - - - - -	6	16	1
State, showing the names and compensation of the clerks and other persons employed in that department during the year 1849. Report of the Secretary of	10	29	1
State, showing the disbursements of the appropriations for the service of that department, including foreign missions. Report of the Secretary of - -	10	30	1
State, relative to the claims of American citizens against the British government for slaves deported in violation of the treaty of September 3, 1783. Report of the Secretary of - - - - - -	10	46	1
State, in relation to the measures taken by him upon the memorial of Ladislaus Wankowicz, great grandnephew of General Kosciusko, and Gaspard Tochman, attorney of the heirs of General Koscuisko, against Alexandre de Bodisco, the Russian minister. Report of the Secretary of - - -	13	50	1
State, respecting the trade in guano. Report of the Secretary of - - - - - - -	13	59	1
State, relative to the boundary line between the British and French possessions in North America, as fixed by the treaty of Utrecht. Extract of a letter from the United States minister at London, to the Secretary of - - - - - - - -	14	71	1
State, relative to suits instituted in the courts of admiralty in the United States against foreign vessels entering our ports. Report of the Secretary of -	14	78	1
State, enclosing a copy of a despatch received from Mr. J. R. Clay, chargé d'affaires at Lima, respecting Peruvian guano. Report of the Secretary of -	14	80	1

	Vol.	No.	Page.
State, communicating further information in relation to the formation of a State government in California; and also in relation to the condition of civil affairs in Oregon. Report of the Secretary of - -	13	52	1
State Department during the year 1849. Statement of the names and compensation of clerks and others employed in the - - - - - -	10	29	2
State Department, including foreign missions. Statement of disbursements of appropriations for the -	10	30	2
State, communicating the report of the Rev. R. R. Gurley, who was recently sent out by the government to obtain information in respect to Liberia. Report of the Secretary of - - - - -	14	75	1
Steamboat mail service. (See *Mail service.*)			
Steam-vessels. Report in relation to an alleged non-compliance of contract to carry the United States mail on the routes between New York and Liverpool, and Charleston and Havana, &c., in - -	14	77	1
Steamer. Report of the Chief of the bureau of Construction, &c., relative to contracts with Mr. R. L Stevens, for the construction of a war shot and shell-proof - - - - - -	1	1	446
Stores. (See *Navy-yards.*)			
Storms. Report of Professor Espy in relation to -	11	39	1
Suits instituted in courts of admiralty against foreign vessels entering ports of the United States. Report in relation to - - - - - -	14	78	1
Superintendent of the coast survey for the year ending November, 1849. Report of the - - -	5	5	1
Surgeon General of the army for 1849. Annual report of the - - - - - - -	1	1	206
	6	26	41
Surveys of routes for military roads from the valley of the Mississippi to the Pacific ocean. Report of -	1	1	154
Survey of the gulf coast, at the mouth of the Rio Grande. Report of Lieut. Webster of a - - - -	14	65	1
Survey of the Savannah river. Lieutenant Smith's report of a - - - - - - -	6	19	1
Surveys of lakes, harbors, &c., by the corps of topographical engineers, in 1849. Report relating to	1	1	294
Surveyor general of Iowa and Wisconsin. Annual report of the - - - - - -	2	1	232
Surveyor general of Illinois and Missouri. Annual report of the - - - - - -	2	1	251
Surveyor general of Ohio, Indiana and Michigan. Annual report of the - - - - -	2	1	282
Surveyor general of Arkansas. Annual report of the -	2	1	313
Surveyor general of Louisiana. Annual report of the -	2	1	328
Surveyor general of Florida. Annual report of the -	2	1	361
Survey of the mineral lands in Michigan, by Charles T. Jackson, United States geologist for said State. Report of a - - - - - -	3	1	371

	Vol.	No.	Page.
Surveys of lands with reference to mines and minerals in the northern peninsula of Michigan. Reports of linear (*See index to same, at page* 803.)	3	1	811
Swamp lands. (See *Lands.*)			
T.			
Texas, in 1849. Report of military operations in -	1	1	138
Texas boundary. Correspondence in relation to the -	6	24	1
Texas to the jurisdiction over that country. Correspondence in relation to military orders issued to the United States officers at Santa Fe, and between those officers and the War Department, in relation to the claims of - - - - -	13	56	1
Texas to jurisdiction over part of New Mexico. Message of the President of the United States, relative to the claim of - - - - - -	14	67	1
Texas and the adjacent Mexican States on the Rio Grande, accompanied by astronomical observations and descriptive and military memoirs of the country. Report and map by Captain Hughes of the march of the United States army, under General Wool, from San Antonio de Bexar to - - -	10	32	5
Texas. Report of Lieutenant Whiting's reconnaissances of the western frontier of - - - -	14	64	1
Tochman. (See *Kosciusko.*)			
Tonnage engaged, &c. Report of the Topographical Bureau in relation to the commerce of the lakes, number of seamen employed, and the amount of American - - - - - -	10	48	1
Topographical Bureau, with a copy of P. T. Tyson's report upon the geology of California. Report of the	10	47	1
Topographical Bureau of engineers in relation to the commerce of the lakes, American tonnage engaged, and the number of seamen employed thereon, &c. Report of the - - - - - - -	10	48	1
Topographical engineers, with estimates for 1849. Annual report of the Colonel of the corps of -	1	1	294
Topographical engineers, &c., with a map descriptive of the march of General Wool's division of the army from San Antonio de Bexar, in Texas, to Saltillo, in Mexico. Memoir of Captain Hughes, of the -	10	32	5
Transfers. (See *Appropriations.*)			
Treasury on the state of the finances. Report of the Secretary of the - - - - -		2	1
Treasury, transmitting a report from the Register of the Treasury of the commerce and navigation of the United States for the year ending June 30, 1849. Report of the Secretary of the - - -		3	1
Treasury, of the disbursement or application of moneys, &c., for the benefit of the Indians, for the year ending September 30, 1848. Report of the Second Auditor of the - - - - -		4	1

	Vol.	No.	Page.
Treasury, communicating the report of the superintendent of the coast survey, showing the progress of that work during the year ending November, 1849. Report of the Secretary of the - - -		5	1
Treasury, with a statement of the claims of the Cherokee nation of Indians, according to the principles established by the treaty of August, 1846. Report of the Second Auditor and Second Comptroller of the - - - - - -		6	1
Treasury, with statements of contracts authorized by that department, of payments for the discharge of miscellaneous claims, and of expenditures from the marine hospital fund for the relief of sick and disabled seamen. Report of the Secretary of the -		31	1
Treasury, with copies of the accounts of disbursements for the benefit of the Indians. Report of the Second Auditor of the - - - - -		41	1
Treasury in relation to the measures adopted to prevent frauds upon the revenue since the passage of the act of 1846. Report of the Secretary of the -		79	1
Treasury in relation to the security and collection of the revenue in California, &c., accompanied by a report from Gilbert Rodman, esq., special agent. Report of the Secretary of the - - -		82	1
Treasury relative to the commerce of the port of Brazos de St. Jago. Report of the Secretary of the -		69	1
Turkish government on the subject of the Hungarian exiles. Correspondence with the - -	14	81	1

U.

United States mail. (See *Mail.*)

V.

Valparaiso. Correspondence in relation to the resentment of an indignity offered at Lima, by the British chargé d'affaires, to the lady of the American consul at - - - - - - -	6	16	1
Vessels by British ships-of-war. Correspondence in relation to the searching of American - -	14	66	1
Vessels entering the ports of the United States. Report of Secretary of State, with correspondence relating to foreign - - - - - -	14	78	1
Vessels in commission November 1, 1849. Statement of -	1	1	464
Vessels in ordinary November 1, 1849 Statement of -	1	1	466
Vessels on the stocks and in progress of construction, November 1, 1849. Statement of - -	1	1	467
Vessels broken up, sold, or lost, since the last annual report. Statement of - - - -	1	1	468

	Vol.	No.	Page.
W.			
Wankowicz. (See *Kosciusko.*)			
War steamer. (See *Steamer.*)			
War, accompanying the President's annual message, of the operations of the War Department during the year 1849. Report of the Secretary of - -	1	1	90
War, with statements of expenditures of the various offices and bureaus of that department during the fiscal year ending 30th June, 1849. Report of the Secretary of - - - - - -	6	9	1
War, with a statement showing the appropriations and expenditures for the service of that department during the fiscal year ending 30th June, 1849. Report of the Secretary of - - - -	6	10	1
War, communicating a map of the valley of Mexico, from surveys by Lieutenants Smith and Hardcastle. Report of the Secretary of - - - -	6	11	1
War, communicating the report and map of the route from Fort Smith, Arkansas, to Santa Fe, New Mexico, made by Lieutenant Simpson. Report of the Secretary of - - - - - -	6	12	1
War, with Lieutenant Colonel Long's plan and estimate for the repair of the Cumberland dam. Report of the Secretary of - - - - - -	6	14	1
War, communicating a copy of Lieutenant Smith's survey and examination of the Savannah river. Report of the Secretary of - - - - - -	6	19	1
War, communicating copies of reports, plans, and estimates for improving the entrances from Lake Michigan into Maskegon lake, Black river, and Grand river. Report of the Secretary of - -	6	20	1
War, showing the names of all persons employed in the several branches of the War Department, other than army officers, during the year 1849. Report of the Secretary of - - - - -	6	23	1
War, with an abstract of the returns of the militia, their arms, accoutrements, and ammunition. Report of the Secretary of - - - - -	6	25	1
War, with a statement of the expenses of the national armories, and the number of arms and appendages made and repaired, during the year ending 30th June, 1849. Report of the Secretary of - -	6	27	1
War, communicating the report of an exploration of the Territory of Minnesota, by Brevet Captain Pope. Report of the Secretary of - - - -	10	42	1
War, communicating a report of the Topographical Bureau, in relation to the commerce of the lakes, the amount of American tonnage engaged, and the number of seamen employed thereon. Report of the Secretary of - - - - - -	10	48	1

	Vol.	No.	Page.
War, communicating reports of Generals Smith and Riley, Lieutenants Talbot and Ord, Mr. Tyson, and Professor Frazer, in relation to the geology, mineralogy, and topography of California and Oregon. Report of the Secretary of - -	10	47	1
War Department in relation to surveys of routes for roads from the valley of the Mississippi to the Pacific ocean, (part 1.) Report and correspondence of the	1	1	155
War Department, in relation to military operations in California. Report and correspondence of the -	1	1	156
War, showing the contracts made under the War Department, during the year ending June 30, 1849. Report of the Secretary of - - - - -	6	26	1
War, communicating a map showing the operations of the army of the United States in Texas and the adjacent Mexican states on the Rio Grande, accompanied by astronomical observations, and descriptive and military memoirs of the country. Report of the Secretary of - - -	10	32	1
War, with reconnaissances of routes from San Antonio to El Paso, by Brevet Lieutenant Colonel J. E. Johnston, Lieutenants Smith, Bryan, and Michler, and Captain S. G. French, of the quartermaster's department. Report of the Secretary of -	14	64	1
War, in relation to the operations of the army on the Rio Grande. Report of the Secretary of - -	14	73	1
War and Interior to General Twiggs, and S. Spencer, sub-agent, respecting the removal of the Seminole Indians remaining in Florida, dated 17th September, 1849. Instructions of the Secretaries of -	2	1	961
War, communicating the reconnaissance of Lieutenant Simpson and others. Report of the Secretary of -	14	64	1
Webster, of a survey of the gulf coast at the mouth of the Rio Grande. Report of Lieutenant - -	14	65	1
Weightman, accompanying a memorial of the legislature of New Mexico, setting forth sundry grievances, and praying their redress. Communication of R. H. - - - - - -	14	76	1

West Point. (See *Academy.)*

Widow pensioners. (See *Pensions.)*

Y.

Yards and Docks. (See *Bureau of Yards and Docks.)*

TABLE

OF

EXECUTIVE DOCUMENTS,

PRINTED

BY ORDER OF THE SENATE OF THE UNITED STATES,

DURING THE

FIRST SESSION THIRTY-FIRST CONGRESS,

1849–'50.

CONTAINED IN FOURTEEN VOLUMES.

MESSAGES FROM THE PRESIDENT OF THE UNITED STATES, VIZ:

	Vol.	No.	Page.
On the state of the Union, with the accompanying reports and documents	1	1	1
Accompanying documents, viz:			
Proclamation relating to an armed expedition for the invasion of Cuba	1	1	17
Correspondence between the Secretary of State and the Minister of the German Empire	1	1	18
Correspondence between the Secretary of State and the Minister of Mexico	1	1	69
Annual report of the Secretary of War	1	1	90
Documents accompanying report of Secretary of War, viz:			
Letter from Major General Scott	1	1	98
Reports of operations in New Mexico	1	1	104
Reports of operations in Florida	1	1	116
Reports of operations in Texas	1	1	138
Instructions relative to surveys west of the Mississippi	1	1	154
Instructions and reports relative to affairs in California	1	1	156
Report of the Adjutant General	1	1	179
Report of the Quartermaster General	1	1	192
Report of the Paymaster General	1	1	198
Report of the Commissary General	1	1	204
Report of the Surgeon General	1	1	206
Report of the Chief Engineer	1	1	212
Report of the Colonel of the Corps of Topographical Engineers	1	1	294

	Vol.	No.	Pag
Report of the Colonel of Ordnance	1	1	3
Annual report of the Secretary of the Navy	1	1	4
Documents accompanying report of Secretary of the Navy, viz:			
Report of Lieutenant Davis relative to the Nautical Almanac	1	1	4
Report of Professor Page relative to the capacity and usefulness of the electro-magnetic power as a mechanical agent	1	1	4
Report of the Chief of the Bureau of Construction, &c., relative to contracts with Mr. R. L. Stevens for the construction of a shot and shell-proof steamer	1	1	4
List of deaths, resignations, and dismissions in the navy	1	1	4
Aggregate of estimates	1	1	4
General estimate for the office of the Secretary of the Navy and the several bureaus of the Navy Department	1	1	4
Estimate of the sums required for the expenses of the southwest executive building	1	1	4
General estimate for the naval service	1	1	4
General estimate for the marine corps	1	1	4
Detailed estimates from the Navy Department	1	1	4
Report and detailed estimates from the Bureau of Construction, Equipment, and Repair	1	1	4
Report and detailed estimates from the Bureau of Ordnance and Hydrography	1	1	5
Report and detailed estimates from the Bureau of Navy Yards and Docks	1	1	5
Report and detailed estimates from the Bureau of Provision and Clothing	1	1	7
Report and detailed estimates from the Bureau of Medicine and Surgery	1	1	7
Report of the commandant of the marine corps, and detailed estimates from the paymaster and quartermaster of the corps	1	1	7
Statement of the expenditures under the head of contingent expenses, as settled and allowed at the office of the Fourth Auditor of the Treasury Department	1	1	7
Statement of the appropriations for the naval service, viz: balances on hand on the 1st July, 1848; appropriations for the fiscal year 1848–'49; amounts drawn from the treasury during that fiscal year, and the balances on hand on the 30th June, 1849	1	1	7
Annual report of the Postmaster General	1	1	7
Documents accompanying report of Postmaster General, viz:			
Report of the Auditor of the Post Office Department	1	1	7
Report of the First Assistant Postmaster General	1	1	7
Report of the Census Board	1	1	8
Annual report of the Secretary of the Interior	2	1	

Documents accompanying report of Secretary of the Interior, viz:	Vol.	No.	Page.
Report of the Commissioner of the General Land Office	2	1	17
Statement of public lands sold; cash, &c., received; incidental expenses thereon, and payments on account thereof, in the years 1848, and 1st, 2d, and 3d quarters of 1849	2	1	36, 41, 47
Statement of Choctaw certificates relinquished for public lands to 30th September, 1849	2	1	53
Statement of military bounty land warrants returned located for patents during 1847, 1848, and the 1st, 2d, and 3d quarters of 1849	2	1	56
Exhibit of State selections of land under act of 4th September, 1841	2	1	57
Exhibit of the quantity of public lands advertised for sale in 1849, the quantity for which the plats of survey have been returned to the General Land Office, &c.	2	1	58
Synopsis of public lands advertised for sale since 30th November, 1848, and showing the quantity under proclamation exclusive of school lands	2	1	59
Statement of the areas of the several States and Territories, the amount of land disposed of by sale, &c., and the amount undisposed of on the 30th September, 1849	2	1	63
Estimate of appropriations required for the office of the Commissioner of the General Land Office for the fiscal year ending 30th June, 1851	2	1	65
Estimate of appropriations for the surveying department for the fiscal year ending 30th June, 1851	2	1	66
Abstract of entries adjusted and confirmed under act of August 3, 1846	2	1	68
Annual reports of surveyors general and accompanying documents	2	1	232
Annual report of the Commissioner of Indian Affairs (*See schedule of accompanying papers at page* 959.)	2	1	937
Annual report of the Commissioner of Pensions, showing the operations of the Pension Office during the year 1849	2	1	1177
Communicating copies of correspondence with the lady of Sir John Franklin relative to the naval expedition to the Arctic regions under the command of her husband	6	8	1
Communicating information in relation to the abduction, by the Spanish consul, of Rey, alias Garcia, from New Orleans	13	13	1
Communicating information in relation to California and New Mexico	9	18	1
Communicating the report of the director of the mint for the year 1849	6	21	1
Communicating copies of correspondence in relation to the boundary of Texas	6	24	1

	Vol.	No.	Page.
Communicating a copy of the constitution of California	6	28	1
Showing the amount of prize money paid into the treasury under the 8th section of the act of March 3, 1849	10	35	1
Communicating copies of the correspondence with the British minister relative to the trade in British vessels between the Atlantic and Pacific ports of the United States, and the granting of American registers to British-built vessels purchased by citizens of the United States; also to an increase of duty on British produce or manufactures	10	36	1
In relation to the appointment of postmasters by the Postmaster General, which belong only to the President	10	37	1
Communicating copies of correspondence with the agent employed to visit Hungary during the recent war between that country and Austria	10	43	1
Communicating the translation of a note from the Mexican minister in relation to the wild Indians of the United States on the frontier of Mexico	10	44	1
Communicating information relative to hostilities committed by the Seminole Indians in Florida during the past year, their removal, &c.	13	49	1
Transmitting a memorial of Count de Bronno Bronski, in relation to an improved breed of silk-worms, which he desires to have introduced into the United States	13	53	1
Communicating further information in relation to the formation of a State government in California, and also in relation to the condition of civil affairs in Oregon	13	52	1
Communicating correspondence in relation to the assemblage, dispersion, &c., of persons on Round island, coast of Mississippi	13	55	1
In relation to alleged revolutionary movements in the island of Cuba	13	57	1
In relation to military orders issued to the United States officers at Santa Fe, and correspondence between those officers and the War Department in relation to the claims of Texas to jurisdiction over that country	13	56	1
In relation to the payment of the Peruvian indemnity	13	58	1
In answer to a resolution calling for information in relation to the formation of a State government in New Mexico, (parts 1 and 2)	13	60	1
Communicating the report of Lieutenant Webster of a survey of the gulf coast at the mouth of the Rio Grande	14	65	1
In relation to the searching of American vessels by British ships of war	14	66	1
In relation the claim of Texas to jurisdiction over part of New Mexico	14	67	1

	Vol.	No.	Page.
In relation to the commerce of the port of Brazos de St. Iago	14	69	1
Communicating the report of the Commissioner to China, made in pursuance of the act to carry into effect certain provisions of the treaties between the United States and China, and the Ottoman Porte	14	72	1
Transmitting a copy of the constitution adopted by the inhabitants of New Mexico, with a digest of the votes for and against it; also a letter from the members of the convention to the late President of the United States	14	74	1
Communicating a copy of the correspondence between the Department of State and the Turkish government on the subject of the Hungarian exiles in Turkey	14	81	1
REPORTS FROM THE SECRETARY OF STATE.			
Communicating correspondence between the Department of State and the minister of the German empire, in relation to the construction of a war-steamer at New York, alleged to be destined for the German service	1	1	18
Communicating correspondence between the State Department and the Mexican minister, in relation to the protocol of the conferences held previous to the treaty of peace at Queretaro between the United States and Mexico	1	1	69
With the correspondence in relation to the resentment of the indignity offered by the British chargé d'affaires for Chili to the lady of the United States consul at Valparaiso	6	16	1
Showing the names and compensation of the clerks and other persons employed in the State Department during the year 1849	10	29	1
Showing the disbursements of the appropriations for the service of the State Department, including foreign missions	10	30	1
In relation to the claims of American citizens against the British government for slaves deported in violation of the treaty of 3d September, 1783	10	46	1
In relation to measures taken upon the memorial of Ladislaus Wankowicz, great grand-nephew, and Gaspard Tochman, attorney of the heirs of General Koskiusko, against the Russian minister, Alexandre de Bodisco	13	50	1
In relation to regulations concerning the trade in guano	13	59	1
In relation to the boundary line between the British and French possessions in North America, as fixed by the treaty of Utrecht	14	71	
In relation to suits instituted in the courts of admiralty in the United States against foreign vessels entering the ports of the United States	14	78	1

	Vol.	No.	Pag
Transmitting a copy of a despatch received from Mr. J. R. Clay, chargé d'affaires at Lima, respecting Peruvian guano	14	80	
Communicating further information in relation to the formation of a State government in California, and also in relation to the condition of civil affairs in Oregon	13	52	
Communicating a statement of the names and compensation of clerks and others employed in the State Department	10	29	
Communicating a statement of the disbursements of appropriations for the State Department	10	30	
Communicating the report of the Rev. R. R. Gurley, government agent to obtain information in respect to Liberia	14	75	
REPORTS FROM THE SECRETARY OF THE TREASURY.			
On the State of the finances	4	2	
Transmitting a report of the Register of the Treasury of the commerce and navigation of the United States for the year ending 30th June, 4849	5	3	
Communicating the report of the superintendent of the coast survey, showing the progress of that work during the year ending November, 1849	5	5	
Communicating statements of contracts authorized by the Treasury Department, of payments for the discharge of miscellaneous claims, and of expenditures from the marine hospital fund for the relief of sick and disabled seamen	10	31	
In relation to the measures adopted to prevent frauds upon the revenue since the passage of the act of 1846	14	79	
In relation to the security and collection of the revenue in California, &c., accompanied by a report from Gilbert Rodman, special agent	14	82	
In relation to the commerce of the port of Brazos de St. Iago	14	69	
REPORTS FROM THE SECRETARY OF THE INTERIOR.			
On the condition and operations of the Interior Department during the year 1849	2	1	
Communicating statements of the Commissioner of the General Land Office, showing the amount of public land originally contained in each State, the number of acres granted to each State for objects of internal improvement, the number necessary to make the grants to each State equal to the maximum of the State receiving the greatest quantity, and the number necessary to make each grant equal in proportion to the areas of each of the several States	6	17	

	Vol.	No.	Page.
mmunicating a statement of rejected applications for pensions	6	22	1
n relation to the printing for the Interior Department	10	33	1
mmunicating information in relation to the operations of the commission appointed to run and mark the boundary between the United States and Mexico, in parts 1 and 2	10	34	1
In relation to the public lands in the Milwaukie land district	10	45	1
In relation to the expense of the judiciary of the District of Columbia	13	54	1
Showing the quantity of land sold, the amount of money received therefor, and the amount of incidental expenses thereon, in the years 1847, 1848, and 1849	13	63	1
n relation to the swamp and overflowed lands in Louisiana	14	68	1
n relation to the lands embracing the Hot Springs of Arkansas	14	70	1
REPORTS FROM THE SECRETARY OF WAR.			
f the operations of the War Department during the year 1849	1	1	90
relation to surveys of routes for roads from the valley of the Mississippi to the Pacific ocean (part 1)	1	1	155
relation to the military operations in California	1	1	156
owing the contracts made under the War Department during the year ending June 30, 1849	6	26	1
mmunicating a map showing the operations of the army of the United States in Texas and the adjacent Mexican States on the Rio Grande, accompanied by astronomical observations, and descriptive and military memoirs of the country	10	32	1
mmunicating statements of expenditures of the various offices and bureaux of that department during the fiscal year ending 30th June, 1849	6	9	1
mmunicating a statement showing the appropriations and expenditures for the service of the War Department during the fiscal year ending 30th June, 1849	6	10	1
mmunicating a map of the Valley of Mexico, from surveys by Lieutenants Smith and Hardcastle	6	11	1
mmunicating the report and map of the route from Fort Smith, Arkansas, to Santa Fe, New Mexico, made by Lieutenant Simpson	6	12	1
mmunicating Lieutenant Colonel Long's plan and estimate for the repair of the Cumberland dam	6	14	1
nmunicating a copy of Lieutenant Smith's survey and examination of the Savannah river	6	19	1
nmunicating copies of reports, plans, and estimates for improving the entrances from Lake Michigan into Maskegon lake, Black river, and Grand river	6	20	1

	Vol.	No.	Page.
Showing the names of all persons employed in the several branches of the War Department, other than army officers, during the year 1849 - - -	6	23	1
Communicating an abstract of the returns of the militia, their arms, accoutrements, and ammunition -	6	25	1
Communicating a statement of the expenses of the national armories, and the number of arms and appendages made and repaired, during the year ending 30th June, 1849 - - - - -	6	27	1
Communicating a report of an exploration of the Territory of Minnesota by Brevet Captain Pope - -	10	42	1
Communicating a report of the Topographical Bureau in relation to the commerce of the lakes, the amount of American tonnage engaged, and the number of seamen employed thereon - - - - -	10	48	1
Communicating reports of Generals Smith and Riley, Lieutenants Talbot and Ord, Mr. Tyson and Professor Frazer, in relation to the geology, mineralogy, and topography of California and Oregon -	10	47	1
Communicating reports of reconnaissances of routes from San Antonio to El Paso by Brevet Lieutenant Colonel Johnston, Lieutenants Smith, Bryan, and Michler, and Captain S. G. French, of the quartermaster's department - - - - -	14	64	1
Communicating reports of the operations of the army on the Rio Grande - - - - - -	14	73	1
Communicating the reconnaissances of Lieutenant Simpson and others - - - - - -	14	64	1
REPORTS FROM THE SECRETARY OF THE NAVY.			
On the condition and operations of the navy department of the public service during the year 1849 -	1	1	425
Communicating a statement of transfers of appropriations for the naval service during the year ending 30th June, 1849 - - - - - -	6	7	1
Showing the annual number of deaths in the United States squadron on the coast of Africa, and the annual cost of said squadron - - -	10	40	1
In relation to allowances to navy officers - -	13	51	1
Transmitting a copy of the report of Professor Charles G. Page on electro-magnetic power as a mechanical agent for the purposes of navigation and locomotion - - - - - - - -	13	61	1
Transmitting a copy of the report of Professor Espy's "rules for mariners" - - - - -	12	39	1
REPORTS FROM THE POSTMASTER GENERAL.			
On the condition and operations of the Post Office Department during the year 1849 - - -	1	1	773
In relation to the mail service for the year ending June 30, 1849 - - - - - - -	1		79

	Vol.	No.	Page.
In relation to the appointment of postmasters by him which by law the President is required to make -	10	37	1
In relation to the failure of the mail between New York and New Orleans in the year 1849 -	13	62	1
In relation to an alleged non-compliance of contract by proprietors of steam-vessels carrying the United States mail - - - - - -	14	77	1
REPORT FROM THE CENSUS BOARD.			
Communicating to the Senate the report of their contracts for paper, &c. - - - - -	10	38	1
REPORTS FROM THE COMMISSIONER OF THE GENERAL LAND OFFICE.			
On the operations of the General Land Office during the year 1849 - - - - - -	2	1	17
In relation to the public lands in the Milwaukie land district - - - - - -	10	45	1
In relation to claimants of land surrounding the Hot Springs of Arkansas - - - -	14	70	1
REPORTS FROM THE COMMISSIONER OF PATENTS.			
Of the condition and operations of the Patent Office for the year 1849; in relation to arts and manufactures	7	15	1
In relation to agricultural statistics, American agriculture, agricultural meteorology, breadstuffs, crops, &c.,	8	15	1
REPORT FROM THE COMMISSIONER OF INDIAN AFFAIRS.			
On the operations of the Indian Department for 1849 -	2	1	937
REPORT FROM THE COMMISSIONER OF PENSIONS.			
On the operations of the Pension Office in 1849 - -	2	1	1177
DOCUMENTS ON VARIOUS SUBJECTS.			
Report from the Second Comptroller and Second Auditor of the Treasury, exhibiting a statement of the claims of the Cherokee nation of Indians, according to the principles established by the treaty of August, 1846 - - - - - -	6	6	1
Report by Professor Espy of meteorological observations in the year 1849 - - - - - -	11 12	39	1
Report of the Second Auditor of the Treasury, with copies of accounts of disbursements for the benefit of the Indians - - - - -	10	41	1
Communication of R. H. Weightman, accompanying the memorial of the legislature of New Mexico, setting forth sundry grievances, and calling upon Congress for their correction - - - -	14	76	1

31st Congress, 1st Session. [SENATE.] Ex. Doc. No. 1.

MESSAGE

FROM

THE PRESIDENT OF THE UNITED STATES,

TO

THE TWO HOUSES OF CONGRESS,

AT THE

COMMENCEMENT OF THE FIRST SESSION

OF

THE THIRTY-FIRST CONGRESS.

DECEMBER 24, 1849.
Read, and ordered to be printed, with the accompanying documents.

PART III.

WASHINGTON:
PRINTED FOR THE SENATE.
1849.

N.

GEOLOGICAL AND MINERALOGICAL REPORTS.

Report on the geological and mineralogical survey of the mineral lands of the United States in the State of Michigan, made under the authority of an act of Congress approved March 1, 1847, entitled "An act to establish a land office in the northern part of Michigan, and to provide for the sale of mineral lands in the State of Michigan," by Charles T. Jackson, United States geologist for the survey of the mineral lands of the United States in Michigan.

BOSTON, *November* 10, 1849.

SIR: I have the honor of transmitting to your department my report on the geological and mineralogical survey of the mineral lands of the United States in the State of Michigan, made in accordance with the instructions given me by the Hon. Robert J. Walker, late Secretary of the Treasury, and yourself.

With this report I forward the geological maps, plans, sections, drawings, barometrical tables, and a full descriptive catalogue of the collection of rocks, minerals, metals, and ores, which I have collected for the use of the government.

I have made my report as full and minute as was possible under the circumstances in which I was placed, and regret that, being deprived of so many of my materials, I have not been able to describe so large an area of country as I should otherwise have reported upon, or to illustrate my work with so many drawings as I originally intended.

I send you all the reports, field-notes, and other documents communicated to me by my late assistants and sub-agents, according to the instructions you gave me, and presume they will be printed with my report.

I do not consider myself responsible for any errors that may be contained in some of them, not having had an opportunity of reviewing the ground described. I have avoided correcting any statements of personal matters, but wish to say that, in presenting reports containing them, I obey instructions, and, without endorsing those statements, present the reports entire.

I have sent Dr. John Locke's report on magnetic observations, and have requested him to send you some additional matter on the subject, and also his notes or report on the geology of the district which I assigned to him in 1847. His occupations in another service to the country during the past year have prevented his completing his geological report in season to forward to me, but I trust it will be communicated to you in season to be printed with my report.

Mr. Richard Cropley, who has most efficiently aided me in preparing the materials of this report, has drawn up a descriptive catalogue of the specimens, and the whole collection has been nicely packed in new boxes, conveniently arranged for transportation. This catalogue should be printed with my report, since it explains the entire mineralogy of the country I have surveyed.

The collection will be forwarded whenever you shall send me orders to do so.

All the township plats and other documents in my possession will be forwarded to you in a few days. They are not sent now, as they are not required for my report.

Trusting that the report I now send you will prove satisfactory and to the country, I have the honor to be, with high consideratio obedient servant,

CHARLES T. JACKSON,
U. S. Geological Surveyor of the mineral land of the United States in Michi

Hon. THOMAS EWING, *Secretary of the Interior.*

List of plates, wood-cuts, and maps accompanying the report.

Plate 1. Section of Cliff mine, with a view.
Plate 2. Front view of "Cloven Towers," Isle Royale.
Plate 3. North view of "Cloven Towers" Isle Royale.
Plate 4. Section across Isle Royale from Fish island to Conglo bay, with ground plan.
Plate 5. Section of Bohemian and Lac la Belle mines, with g plan.
Plate 7. Section from northeast end of Torch lake to Lake Su near the mouth of Eagle river.
Plate 8. Section from Lake Superior to Gratiot lake, with ground also, ground plan of Northwest mines.
Plate 9. Section south from Eagle Harbor, with ground plan.
Plate 10. Section from Lac la Belle to Copper Harbor, with groun also a view showing Bohemian mountain, Mount Houghton, anc Gris bay.
Plate 11. Section of Lake Superior Company's mines, Eagle riv
Plate 12. Section of Eagle Harbor Company's works, with groun
Plate 13. Section of Northwestern Company's works, with groun
Plate 14. East sectional view of Copper Falls mine, with a north v the mine.
Plate 15. Section of Northwest Company's works.
Plate 16. Section of North American Company's works, with groun
Plate 17. Section of Medora works, with ground plan.
Plate 18. View of "Arched Rock," Mackinac.
Plate 19. View of "Sugar Loaf," Mackinac.
Wood-cut No. 1, representing the wood-work at the mouth of
Wood-cut No. 2—view of "Mirage at Rock Harbor."
Wood-cut No. 3—section of the trap and sandstone at Copper showing the vein cutting through.
Wood-cut No. 4—sketch of a plate of copper and silver.
Geological map of Keweenaw point. (Large map.)
Geological map of Isle Royale. (Large map.)
East sectional view of the Lac la Belle mines, with ground plan. (plan.)
East sectional view of the Northwest Company's mine, with g plan. (Large plan.)
Section of Cliff mine, with ground plan and plan of stamps. (plan.)

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INTRODUCTORY REMARKS.

Justice to our predecessors requires that a short review of what was discovered in ancient times concerning the minerals on the shores of Lake Superior should be introduced into this report, and I shall endeavor to condense the remarks that may be necessary for an exposition of the facts into as narrow limits as the subject will permit, and shall refer the reader to more ample details printed elsewhere.

Remains of ancient mining operations on Lake Superior.

Long anterior to the settlement of this country by white men the children of the forest were familiar with the use of native metals, such as gold, silver, copper, and perhaps meteoric iron. Their wandering mode of life prevented the cultivation of the metallurgic art, and it is not supposed that they knew how to reduce metals from their ores by the forge or furnace. There is reason to believe that the aborigines in some parts of the country understood the art of obtaining metallic lead from the sulphuret, for the metal is so readily reduced from that ore by roasting it on an ordinary log fire, that it seems impossible for them to have failed to obtain lead if they even threw pieces of the ore into a fire. In the western States, where the lead ores occur loose in the soil and in decayed seams of the rocks, the Indians would have been most likely to have discovered the art of smelting lead. That metal is probably the only one they knew how to extract from its ores; but they understood the art of annealing the native metals by means of fire, and we find proofs in the ancient workings on Lake Superior, as well as in the accounts recorded by the ancient French Jesuits, who were the first Europeans that visited the lake, that the Indians built fires on and around the masses of native copper which were too large to be removed, and after softening the metal, cut off portions with their hatchets. They understood how to fashion the malleable native metals into all the various weapons, ornaments, or tools employed by them, and manifested considerable ingenuity and skill in this handicraft, but no proofs have ever been discovered that they ever made any castings of metals fusible at a high temperature. Throughout the continent, wherever gold, silver, or copper is found native in the soil, or in the decayed rocks, the aboriginal inhabitants were accustomed to work these metals into various articles, by hammering them with smooth stones, affixed to a withe bound round, in a groove cut in the middle of the stone. With such tools the Indians beat out the native metals into the forms they desired, broke hard quartz, jasper, and hornstone into arrow and spear-heads, beat down the walls of decayed metalliferous veins so as to extract pieces of the metal, and by differently shaped stone tools they fashioned their various implements of wood or stone—the results of their ingenuity and perseverence exciting, with justice, the admiration of civilized nations. Native copper was an invaluable metal to the Indian tribes in North America. It must have given to the nations possessing it great power over their neighbors, and by exchanging of the metals for other articles the Indians must have carried on a most extensive trade. It seems to be proved by the fact that tools of native copper derived from Lake Superior are found in many of the western States, both in the soil and in the ancient mounds. Dr. Locke informs me that he discovered pieces of copper containing

specks of silver in some of the mounds of Ohio, long before it was known that such a mixture of the metals occurred on the shores of Lake Superior; and on being shown some specimens of the Lake Superior metal, he at once recognised its character as indicating a similar origin.

I would take occasion to observe here, that only one other locality of a mixture of native copper and silver is known in the United States, and that is in Somerville, New Jersey. I saw there a mass of native copper extracted from the old Bridgewater mines, and observed numerous lumps of silver projecting from its surface, while they were firmly united to the copper at the point of contact. The copper of the New Jersey mines is, like that of Lake Superior, associated with trap rocks and new red sandstone. It is not probable that the New Jersey mines ever furnished any considerable quantities of copper to the Indians, for it was not situated so that they would have been likely to discover it, and I think there can be no doubt that most of the copper circulated among the Indian tribes in ancient times must have come from the shores of Lake Superior.

It has been suggested that a more civilized people than those who are supposed to have built the mounds in Ohio, Kentucky, and some of the other western States, might have been the original copper miners of Lake Superior. It is certain that they had pieces of the metal in their possession, for it is found buried in the mounds; but it is more probable that they obtained it by trading with the Indian tribes living on the borders of the great lake. We know that a trade in stone arrow-heads extended over many hundreds of miles; for the stones can be identified by comparison with the rocks where they were obtained, and I know that the rocks on Moose Head lake, in Maine, furnished many of the stone used by the Indians in Massachusetts; and that the red jasper of Lynn and Malden has furnished them for the Indians of New York, and perhaps of the more western States. If arrow-heads were circulated in trade, most assuredly native copper must have been still more likely to have been valued by the Indians, and have been an article of traffic among the tribes. To the Indians it must have been very serviceable for many purposes, answering for most of the weapons and tools required. That the mining was performed by the Indians having about the same degree of civilization as that of other northern tribes, cannot be doubted by those who see the rude tools dug up in the ancient excavations on Keweenaw point. The stone hammers made of oval polished shore pebbles, grooved in the centre for a withe which served for a handle, are exactly such as the Indians of Maine, New Hampshire, Massachusetts, and Rhode Island employed anterior to the settlement of this country by Europeans. The Indians here used such hammers to break up the stones of which they made their arrow-heads, and on Lake Superior the native tribes employed them for similar purposes, and for breaking out pieces of native copper from decayed veins. The Indian miner assisted the operation by kindling a fire on the rocks he wished to break, and hence the origin of charcoal and charred fire-brands which have been found in the ancient mines on the Ontonagon river.

None of the ancient excavations thus far discovered extend to more than six feet in depth, and are such as Indians would be most likely to have made. Furthermore, we found half-finished scalping knives and spear-heads in the soil near the Eagle river copper-mine; and those instruments bear ample evidence of their Indian origin.

We may therefore consider this question as settled, that the ancient Chippewas wrought many of the copper-veins, as well as the loose masses of native copper which they found on the shore of the lake and in the beds of the streams. In the course of this report, I shall mention particular localities where the facts on which this opinion rests were observed.

Early explorations on Lake Superior.

It is not surprising that the Indian priests should have exerted themselves to gain the control of the native copper-mines, and that they should have endeavored not only to monopolize the exorcising of the Evil Manitou, who was supposed to be intrusted with the guardianship of this valuable metal, but that they should impress on the superstitious minds of the Indians the necessity of keeping the valuable localities a profound secret from all strangers, warning them that they would die if they revealed them. This superstition the ancient Jesuit fathers found to be universal among the Chippewas two hundred years ago; and even to this day it has been found difficult for the explorers of mines to obtain from the Indians information concerning localities of copper. They are also very unwilling to part with any pieces of the metal they may have in their possession.

There is also an ancient superstition concerning Keweenaw point, which prevented the Indians from settling there. It was the general belief that the Evil Manitou resided there; and the point does not appear to have been inhabited by the Indians, but was only visited by them at certain times for the purpose of obtaining copper. Then, by ceremonious rites and offerings to the Evil Spirit, permission was obtained from him by the priests to dig for copper. The Indian priests thus kept the control of the mineral region in their hands, and gained thereby power, influence, and consideration, which doubtless were as much valued by the red men as they now are by their white successors.

It is not improbable that the scarcity of game in the wilderness on Keweenaw point may have added to the Indians' aversion to settlement upon that peninsula; but fish are abundant enough near its shores, so that they could have lived there, had they chosen to do so.

Those portions of the point north of Portage lake were but little visited by the Indians, or even by the early French *voyageurs;* for in canoe navigation they naturally chose the safer route to La Pointe by coasting round Keweenaw bay to Portage lake, and following that lake to the short carrying-place, over which they bore their canoes again to the great lake, and on returning they took the same passage. Thus the Jesuit missionaries did not visit the localities where the veins of copper were most prominent, and hence they were not discovered by them. The Indians, as the missionaries themselves declare, were very averse to giving information concerning the localities of copper, and they therefore did not communicate to them all they knew.

Soon after the establishment of the French colonists in Canada, the Jesuit fathers came and joined their efforts in spreading the Christian religion over the northern portion of this country. This "opened the way for the advent of that succession of earnest and indefatigable Jesuit missionaries to whose annual narratives of their progress and labors we are indebted for a great portion of what we know of the early discoveries and

state of the vast regions around the great American lakes. They spread themselves, in spite of the elements, and of man, (more implacable, cruel, and merciless than the storms of winter,) from the shores of Nova Scotia and Maine to the great streams and lakes of the far west, and from the shores of the Gulf of Mexico, through the valley of the Mississippi, to frozen regions far up toward the great bay of Hudson."

Omitting all details which do not concern the discovery of minerals, or prove the uses made of them by the Indian tribes, I shall refer the reader for an account of other matters to the original French works.

The first account of the occurrence of native copper on the lakes is in the work of "Lagarde," published in Paris in 1636, in which we find some interesting remarks concerning the richness of the country. He says: "There are mines of copper which might be made profitable, if there were inhabitants and workmen who would labor faithfully. That would be done, if colonies were established. About eighty or one hundred leagues from the Hurons there is a mine of copper, from which Truchement Bruslé showed me an ingot, on his return from a voyage which he made to the neighboring nation." "It is pretended also that, near Saguenay, gold, rubies, and other precious stones are found." "He is assured that, in the country of the Souriquois, there are not only mines of copper, but also of steel; also, certain blue transparent stones, which are as valuable as turquoises." It would appear from the above passage that the author of this history was not very familiar with mineralogy. He remarks, that among the rocks they found stones covered with diamonds, which were attached to the rock—some of them appearing as if from the hands of the lapidary, so beautiful were they. He says, however, "he is not sure they were *fine*, but they were very handsome, and would write upon glass." He says: "It seems that one might find mines of iron and many other minerals, if one would take the trouble of searching, and go to some expense. There is an abundance of limestone, and of wood and other materials required for building." This account was probably obtained from the Indians, for the missionaries did not penetrate so far as Lake Superior until some time afterwards. In the "Relaçion de ce qui s'est passé dans le pays des Hurons," there is much information concerning the "Lac Superiour." The origin of the name "*Green Bay*," on Lake Michigan, is also shown to be derived from a corruption of the French name "*Grande Baye*"—an arm of the "Lac des Illinois."

The "Relaçions" for 1659–'60 give an account of one of the Jesuit fathers "residing near the lake which we call Superieur." "It is enriched on all its borders by mines of lead almost pure, and of copper all refined in pieces as large as the fist, and great rocks which have whole veins of turquoises." Is it not probable that this author mistook the green hydrous silicate of copper or chrysocolla of Copper Harbor for turquoise? The Indians may have brought pieces of the "green rock" to the missionary, and its color would lead those not familiar with minerals into this error. This writer says, also, that little scales of gold are borne down the rivulets, which he regards as coming from the debris of some mine of that metal. He says they found a vein of gold sand as big as his arm, in laying the foundations of the chapel St. Joseph, on the borders of Lake Huron; but the gold was in minute proportion. He describes a vein of copper pyrites as opened by his workmen, who mistook it for "an ore of brass, not knowing that brass was a composition;" and

remarks, "that they laid up the foundations of the chapel, without knowing that they had found a treasury."

In a small duodecimo volume of 168 pages, published in Paris in 1640, by Pierre Boucher, entitled "Histoire veritable et Naturelle des Moeurs et productions du pays de la Nouvelle France, vulgairement dite le Canada," are found the following passages:

"There are mines of copper, tin, antimony, and lead. Many believe there are also deposites of sulphur (des souffriers.) A manufacturer of saltpetre told him that it would be found as abundant and as good as in any other part of the world, and in quantity."

"In Lake Superior there is a great island which is fifty leagues in circuit, in which there is a very beautiful mine of copper; it is found also in various places in large pieces all refined."

There are other places in those quarters where there are similar mines: so I learned from four or five Frenchmen who lately returned, and who went with a Jesuit father on a mission, and died. They were gone three years without finding an opportunity to return; they told me that they had seen an ingot of copper all refined, which was on the coast, and which weighed more than 800 lbs. according to their estimation. They said that the savages, on passing it, made a fire on it, after which they cut off pieces with their axes. One of them, wishing to do so, broke his axe."

"They told me, also, that they found beautiful blue stones, which are believed to be turquoises. They found, also, grèen stones, like emeralds, (green fluor spar?) There are diamonds, also; but I do not know that they are fine."

In the Relaçion for 1666–'67, chap. ii., page 32 *et seq.*, entitled "Relaçion de la Mission du St. Esprit, aux Outaouacs dans le lac Tracy dite aupravant le Lac Superieur; Journal du voyage du Pere Claude Allouez dans le Pais des Outaouacs," we find these passages:

"The savages respect this lake as a divinity, and make sacrifices to it, on account, perhaps, of its magnitude, for it is two hundred leagues long and eighty wide; or on account of its goodness in furnishing them with fishes, which nourish all these people where there is but little game. There are often found beneath the water, pieces of copper all formed, and of the weight of ten and twenty pounds. I have seen them many times in the hands of the savages; and as they are superstitious, they keep them as so many divinities, or as presents from the gods beneath the water, who have given them as pledges of good fortune. On that account they keep the pieces of copper enveloped among their most precious furniture. There are some who have preserved them for more than fifty years, and others who have had them in their families from time immemorial, and cherish them as household gods."

"Some time since a large mass of copper, like a rock, was seen with the point projecting out of the water. This afforded passers-by an opportunity of cutting off pieces. Nevertheless, when I went by there it was not to be seen. I believe the storms, which are here very violent and like those on the sea, had covered the copper rock with sand. Our savages wished to persuade us that it was a divinity, and had disappeared, for some reason which they did not mention."

"*De la Mission du Sainte Esprit a la Pointe de Chagaouamigond dans le Lac Tracy ou Superieur*—chap. xi., des Proprietez et Raritez."

From the above work I have translated the following interesting description of the form of Lake Superior, and of the copper found there:

"The lake has nearly the form of a bended bow, of more than eighty leagues in length. The southern side represents the string, and a long tongue of land which springs from the centre of the southern shore, and projects upwards of twenty-five leagues into the lake near to its middle, is the arrow." (Keweenaw point.)

"The northern coast is bordered with frightful crags, which are the termination of that prodigious chain of mountains which take their rise at Cape Tourment, above Quebec, and extend to this place, traversing more than six hundred leagues in extent, and losing themselves at the farther extremity of the lake. There are very few islands in the lake, and they occur mostly on the northern side near the shore. This great expanse of the waters gives room for the winds, which agitate the lake with as much violence as they do the ocean."

On page 26 is a chapter headed "Mines of Copper which are found on Lake Superior."

"Up to the present time it was believed that these mines were found on only one or two of the islands; but since we have made a more careful inquiry, we have learned from the savages some secrets which they were unwilling to reveal. It was necessary to use much address in order to draw out of them this knowledge, and to discriminate between the truth and falsehood. We will not warrant, however, all we learned from their simple statements, since we shall be able to speak with more certainty when we have visited the places themselves, which we count on during this summer, when we shall go to find the 'wandering sheep' in all quarters of this great lake. The first place where copper occurs in abundance after going above the Sault is on an island about forty or fifty leagues therefrom, near the north shore, opposite a place called Missipiconatong.

"The savages say it is a floating island, which is sometimes far off and sometimes near, according as the winds move it, driving it sometimes one way and sometimes another. They add that, a long time ago, four Indians accidentally went there, being lost in a fog, with which this island is almost always surrounded. It was long before they had any trade with the French, and they had no kettles or hatchets. Wishing to cook some food, they made use of their usual method, taking stones which they picked up on the shore, heating them in the fire, and throwing them into a bark trough full of water in order to make it boil, and by this operation cook their meat. As they took up the stones they found they were nearly all of them pure copper. After having partaken of their meal they thought of embarking, fearing to remain lest the lynxes (loups cerviers) and the rabbits, (lievres) which are in the place as large as dogs, (!) would come and eat up their provisions, and even their canoe. Before leaving they collected a quantity of these stones, both large and small ones, and even some sheets of copper, but they had not gone far from the shore before a loud voice was heard, saying in anger, 'Who are these robbers who have stolen the cradles and playthings of my children?' The sheets of copper were the cradles, for the Indians make them of one or two pieces

of wood, (a flat piece of bark with a hoop over one end,) the child being swathed and bound upon the flat piece. The little pieces of copper which they took were the playthings, such pebbles being used by Indian children for a like purpose. This voice greatly alarmed them, not knowing what it could be. One said to the others, it is thunder, because there are frequent storms there; others said, it is a certain genii whom they call Missibizi, who is reputed among these people to be the god of the waters, as Neptune was among the Pagans; others said that it came from Memogovissiousis—that is to say, sea-men, similar to the fabulous Tritons, or to the Syrens, which live always in the water, with their long hair reaching to their waists. One of our savages said he had seen one in the water: nevertheless, he must have merely imagined that he did. However, this voice so terrified them that one of these four *voyageurs* died before they reached land. Shortly after, a second one of them expired; then a third; so that only one of them remained, who, returning home, told all that had taken place, and died shortly afterwards. The timid and superstitious savages have never since dared to go there for fear of losing their lives, believing that there are certain genii who kill those who land there; and within the memory of man no one has been known who has set foot on that shore, or even coasted along its shores, although the island is within sight, and even the trees are visible upon another island called Achemikonan.

"There is both truth and error in this story, and this is most probably the explanation: These four savages were poisoned by the water which they boiled with red hot copper, which, by the intensity of the heat, gave off their poison, &c. It is not a poison which acts immediately, and on one as soon as it will on another, as happened in this case. It may be that when they were taken ill, they more readily imagined they heard a voice: perhaps they heard an echo, such as are very common among the rocks which border this island; or perhaps they made this fable since, not knowing to what to attribute the death of these Indians. When they said it was a floating island, it is probable they may have been misled by the vapors which surround it; they being rarified or condensed by the variable action of the sun's rays, made the island appear sometimes near and sometimes far off. It is certain, however, that it is a common belief among the Indians that there is a great abundance of copper on this island; but they dare not go there. We hope to begin our discoveries upon it this summer.

"Advancing to a place called the Grand Anse, (Great bay,) we meet with an island three leagues from land, which is celebrated for the metal which is found there and for the thunder which takes place, because they say it always thunders there, (Thunder cape.) But further towards the west, on the same north shore, is the island most famous for copper, called Minong, (the good place,) Isle Royale. This island is twenty-five leagues in length; it is seven leagues from the main land and sixty from the head of the lake. Nearly all around the island, on the water's edge, pieces of copper are found mixed with pebbles, but especially on the side which is opposite the south, and principally in a certain bay which is near the northeast exposure to the great lake. There are shores 'tous escarpez de terre glaize,' and there are seen several layers or beds of copper, one over the other, separated or divided by other beds of earth or rocks. In the water is seen copper sand, and one can take up in spoons grains of the

metal big as an acorn, and others fine as sand." (This description probably refers to Rock harbor.) "This island is almost surrounded with islets which are said to be composed of copper, and they are met with even to the main land on the north. One of them is two gun-shots from Minong. It is near the middle of the island, and the end which looks towards the northeast; and farther out on this side, there is another island called Manitouminis, on account of the copper which abounds on it; and it is said that those who were there on one occasion, on throwing stones, made it resound like an explosion.

"Advancing to the head of the lake and returning one day's journey by the south coast, there is seen on the edge of the water a rock of copper which weighs 700 or 800 pounds, and is so hard that steel can hardly cut it; but when it is heated, it cuts as easily as lead. Near Point Chagaouamigong, where a mission was established, rocks of copper and plates of the same metal were found on the shores of the islands.

"Last spring we bought of the savages a sheet of pure copper, two feet square, which weighed more than 100 pounds. We do not believe, however, that the mines are found on these islands, but that the copper was probably brought from Minong, (Isle Royale,) or from other islands, by *floating ice*, or over the bottom of the lake by the impetuous winds, which are very violent, particularly when they come from the northeast.

"Returning still towards the mouth of the lake, following the coast on the south, at twenty leagues from the place last mentioned, we enter the river called Nantounagan, (Ontonagon,) on which is seen an eminence where stones and copper fall into the water, or upon the earth: they are readily found. Three years since, we received a piece which was brought from this place which weighed a hundred pounds, and we sent it to Quebec, to M. Talon. It is not certain exactly where this was taken from: some think it was taken from the forks of the river; others that it was from near the lake and dug up from the soil.

"Proceeding still further, we come to the long point of land which we have compared to the arrow of the bow, (Keweenaw point;) at the extremity of this there is a small island which is said to be only six feet square, and all copper!

"We are assured that copper is found in various places along the southern shore of the lake. All the information we obtained from others it is not necessary for us to detail; but it seems necessary that more exact researches should be made, and this is what we shall endeavor to effect. If God prospers us in our enterprise, we shall speak next year with more certainty and knowledge."

The Relaçion of 1670–'71 contains the remarks of Pere Ablon. In the second part, he gives an account of the copper mines, page 91: "We would remark, by the way, that copper is found in all parts of this lake, although we have not, as yet, sufficiently exact knowledge, for want of thorough explorations; nevertheless, the plates and masses of this metal which we have seen, weigh each a hundred or two hundred pounds, and much more. The great rock of copper of 700 or 800 pounds, and which all the travellers saw near the head of the lake, besides a quantity of pieces which are found near the shores in various places, seem not to permit us to doubt that there are somewhere the parent mines, which have not been discovered."

"*Voyages du Baron de la Houtan dans l'Amerique Septentrionale,* 688."

In this work, volume 2, "Description abrigé du Canada," he says: Lake Superior is five hundred leagues in circumference, including all the ays and inlets. This little fresh-water ocean is tranquil enough from ıe 1st of May to the end of September. The southern coast is the afest for canoe navigation on account of the numerous bays and rivers, /here one can stop during storms, &c. There are on this lake mines of opper, the metal being so pure that there is not a seventh of loss. There re also some islands full of caribous," &c.

Peter Francis Xavier de Charlevoix, a Jesuit, was born at St. Quentin, ı France, in 1682. He made a tour of the American lakes in 1721, but e does not appear to have visited Lake Superior. He says: "On the ıast of this lake (Superior) large pieces of copper are found, which are ›jects of *superstitious worship* among the savages. They regard them ith veneration, as presents from the gods which inhabit the waters. hey collect little pieces and preserve them with care, but make no use them. They say that formerly a great rock of copper appeared above ıe surface of the water, and as it is not now seen, they pretend that the ›ds have removed it elsewhere; but it is more probable that in time the aves have covered it with sand and mud. It is certain that great quan- ties of this metal have been discovered in many places without digging uch.

"In my first voyage in this country, one of our brethren, who was a ›ldsmith, while he was at the mission of Sault Ste. Marie, made some ındlesticks, crosses, and censors of it; for this copper is often quite ire."

On page 317 he says "that the Indians believe they would die if they ıould communicate the localities of the mines to strangers." They ave a similar superstition concerning the use of their simple medicines.

Peter Kalm, professor of economy in the University of Aobo, in Swe- ish Finland, travelled through the provinces, and published an account f his travels in 1772. (London: 2 vols. 8vo.) In volume 2, page 399, nder date Montreal, September, 1849, is the following memorandum:

"To-day I got a piece of native copper from the upper lake. They ›und it almost pure, so that it does not want melting over again, but is nmediately fit for working.

"One of the Jesuits at Montreal, who had been at the place where this ıetal is got, told me that it is generally found near the mouths of rivers, nd there are pieces of native copper too heavy for a single man to lift up. 'he Indians say they formerly found there a piece about *seven feet long* nd *five feet thick*, all pure copper. As it is always found in the ground ear the mouths of rivers, it is probable that the *ice* or water carried it own from a mountain. Notwithstanding the careful search which has een made, no place has been found where the metal lies in any great uantity together."

This author appears to have anticipated the glacio-aqueous theory of ransportation of boulders.

English accounts of Lake Superior copper.

The earliest English traveller who visited the shores of Lake Superior, f whom we have any account, is Alexander Henry. His work is en-

titled "Travels and Adventures in Canada and the Indian Territories, between the years 1760 and 1776, in two parts, by Alexander Henry, esq. New York, 1809. Octavo."

Henry was a trader, who, soon after the conquest of Canada by the English, set out on a trading voyage to Fort Mackinaw. He arrived there while the fort was in possession of the English troops, and was present when that dreadful massacre of the whole garrison was effected by the Indians, who took the fort by a most ingenious stratagem. Henry was saved by being suddenly and most unexpectedly adopted as a brother by one of the conquering Indians, and who most carefully guarded him from harm during the subsequent carousals of the Indians, concealing him in a cave on the opposite island—Michilimackinac—the place now called Mackinaw. Referring to his most interesting and evidently truthful narrative for an account of his voyages and perils, and for his general description of the country, I shall limit myself in this review to a few extracts showing the amount of knowledge he possessed of the existence of copper and other metals, or ores, on the shores of Lake Superior. Part II, page 194 *et seq.*, he says:

"On the 19th of August, 1765, we reached the mouth of the Ontonagon river, one of the largest on the south side of the lake. At the mouth was an Indian village; and three leagues above, a fall, at the foot of which sturgeon at this season were obtained so abundant that a month's subsistence for a regiment could have been taken in a few hours. But I found this river chiefly remarkable for the abundance of virgin copper which is on its banks and its neighborhood, and of which the reputation is at present more generally spread than it was at the time of my first visit.

"The attempts which were shortly after made to work the mines of Lake Superior to advantage will very soon claim a place among the facts which I am about to describe.

"The copper presented itself to the eye in masses of various weight. The Indians showed me one of twenty pounds. They were used to manufacture this metal into spoons and bracelets for themselves. In the perfect state in which they found it, it required nothing but to beat it into shape. The Piwâtie or Iron river enters the lake to the westward of the Ontonagon, and hence, as is pretended, silver was found while the country was in possession of the French."

Page 204: "On my way back to Michilimackinac I encamped a second time at the mouth of the Ontonagon river, and now took the opportunity of going ten miles up the river with Indian guides. The object for which I most expressly went, and to which I had the satisfaction of being led, was a mass of copper of the weight, according to my estimate, of no less than *five tons*." (This is the copper rock now on the ground near the State Department, in Washington.) "Such was its pure and malleable state, that with an axe I was able to cut off a portion weighing a *hundred pounds*. On viewing the surrounding surface, I conjectured that the mass at some period or other had rolled from the side of a lofty hill which rises at its back."

Chap. IV, page 211: "The same year (1767) I chose my wintering ground at Michipicoten, on the north shore of Lake Superior.

"At Point Mamance the beach appeared to abound in mineral sub-

tances, and I met with a vein of lead ore where the metal abounded in cubic crystals.

"Still coasting along the lake, (on the north shore,) I found several veins of copper ore of that kind which the miners call 'gray ore.'

"Near Michipicoten bay he says he found on the beach 'several pieces of virgin copper, of which many were remarkable for their form, some resembling leaves of vegetables (dendritic copper,) and others animals.' "

In 1770 Messrs. Baxter, Bostwick, and Henry formed "a company of adventurers for working the mines of Lake Superior." They built a barge at Point aux Pins, and laid the keel of a sloop of forty tons. Early in May, 1771, they sailed for the island of yellow sand, where they expected to find gold, and make their fortunes; but they found nothing of value. The miners examined the coast of Nanibojou, and found several veins of copper and lead, after which they returned to Point aux Pins, and erected an air furnace. "The assayer reported on the ores which they had collected, stating that the lead ore contained silver in the proportion of forty ounces to a ton; but the copper ore only a very small proportion indeed."

From Point of Pins they crossed over to Point aux Iroquois, where Mr. Norberg, a Russian gentleman, acquainted with metals, and holding a commission in the 60th regiment, and then in garrison at Michilimackinac, accompanied us on this latter expedition. As we rambled, examining the shods or loose stones in search of minerals, Mr. Norberg chanced to meet with one of 8 lbs. weight, of a blue color, and semitransparent. This he carried to England, where it produced in the proportion of 60 lbs. of silver to a hundred weight of the ore. It was deposited in the British museum."

It is difficult to say what ore of silver this could have been; but from the character of the gangue at Copper Falls, I suppose it may have been native silver in that kind of veinstone. I have not found chloride of silver in any of the veins, and therefore I do not think it could have been that ore, though at one time I thought it possible.—(See American Journal of Science, vol. XLIX, No. 1.)

Henry revisited the Ontonagon river, where, besides detached masses of copper formerly mentioned, he saw "much of the same metal *bedded in the stone*." They built a house, and sent to the Sault for provisions. He pitched upon a spot for the commencement of mining operations, and remarks that there was "a green colored water which tinged iron of a copper color." This the miners called a "*leader*." In digging they frequently found masses of copper, some of which were three pounds in weight.

On the 20th day of June, 1772, the miners, after passing the winter at the Ontonagon, all returned, and stated that they had penetrated forty feet into the hill, but on the arrival of a thaw the clay, which, on account of its stiffness, they had neglected to secure by supporters, had fallen in, and that to recommence the search would be attended with much labor and cost; that detached masses of metal, which to the last had daily presented themselves, would, they supposed, ultimately lead to some body of it; but they could form no conjecture as to the distance, except that it was so far off as not to be pursued without sinking an air shaft; and lastly, that this work would require the hands of more men than could be found, in the actual situation of the country.

"Here our operations in this quarter ended. The metal was probably within our reach; but, if we had found it, the expense of carrying it to Montreal must have exceeded its marketable value. It was never for the exportation of copper that our company was formed, but always with a view to the *si'ver*, which it was hoped the ores, whether of copper or lead, might in sufficient quantity contain. The copper ores of Lake Superior *can never be profitably sought for but for local consumption.* The country must be cultivated and peopled before they can deserve notice.

"In the following month of August we launched our sloop, and carried the miners to the vein of copper ore on the north side of the lake. Little was done during the winter; but, by dint of labor, performed between the commencement of the spring of 1773 and the ensuing month of September, they penetrated thirty feet into the solid rock. The rock was blasted with great difficulty, and the vein, which at the beginning was of the breadth of four feet, had in the process contracted into four inches. Under these circumstances we desisted, and carried the miners back to the Sault. What copper ore we had collected we sent to England; but the next season we were informed that the partners there declined entering into further expenses. In the interim we had carried the miners along the north shore as far as the river Pic, making, however, no discovery of importance. This year, therefore, (1774,) Mr. Baxter disposed of the sloop and other effects of the company, and paid its debts. The partners in England were, his royal highness the Duke of Gloucester; Mr. Secretary Townshend; Sir Samuel Tuchet, bart.; Mr. Baxter, consul of the Empress of Russia; and Mr. Cruickshank, in America; Sir William Johnson, bart.; Mr. Bostwick, Mr. Baxter, and myself. A charter had been petitioned for and obtained, but owing to our ill success it was never taken from the seal office."

The celebrated traveller, Mackenzie, in describing Lake Superior, merely says, in relation to copper, (vol. 1, London, 1802, page 51) "on the same side (south side of the lake,) at the river Tonnagan, is found a quantity of virgin copper. The Americans, soon after they got possession of that country, sent an engineer thither; and I should not be surprised to hear of their employing people to work the mine. Indeed, it might be well worthy the attention of British subjects to work the mines on the north coast, though they are not supposed to be so rich as those on the south."

George Heriot, deputy postmaster general of British North America, published a large 4to volume of "Travels through the Canadas," &c., in London, in 1807. On page 201 he says: "White Fish point is on the south shore; opposite to which, on the north coast, and at a distance of fifteen miles across, there is a mine of copper, formerly worked by the French. That metal is here found in native purity, uncontaminated by mixture with any extraneous substances."

In more modern times we have the observations of Henry R. Schoolcraft, who accompanied General Cass in his travels on the lake, and who visited the great block of native copper at Ontonagon, an account of which was published, with a plate, in the American Journal of Science, volume 3. During the last war with England, or soon after, Dr. Francis le Baron, of Plymouth, visited Lake Superior and brought home a piece of the great copper rock of the Ontonagon. The first proper scientific explorations in the mineral lands of Lake Superior were made by my late friend, Dr. Douglas Houghton, while employed as the State geologist of Michigan,

and subsequently, while engaged in a connected linear and geological survey, under the direction of the general government. His publications were annual reports, in which he described the geology of the country and the minerals he had discovered. He withheld any designation of localities of the metals and ores, giving only one locality, viz: that of the green silicate of copper, of Copper Harbor. There cannot be a doubt that he was aware of the localities of most of the exposed copper veins, for he had traversed the region where they occur, and was a good observer. It is supposed that he reserved a more full description of the minerals and ores, with that of their localities, for his final report. This, unfortunately, he did not live to write. He perished in the field of his labors, on the coast of Keweenaw point.

First mining explorations on Keweenaw point.

It has long been known that native copper is occasionally found in trap rocks, masses many pounds in weight having been discovered in those rocks, in Connecticut, New Jersey, and Nova Scotia; but no one then supposed that the occurrence of such masses of this metal was of any practical interest, or that it was even probable that any locality would be discovered where it could be economically mined. It was generally believed, by geologists, mineralogists, and miners, that the few isolated lumps of native copper which were occasionally found in amygdaloidal trap and trap breccia were accidental, and were derived from the fusion and reduction of pieces of copper ores which were originally included in the partially altered or fused rocks, through which the injected dikes of trap had been protruded in a molten state. Theories had been formed to account for this supposed origin of native copper; and it was said, that since the sandstones are made up of disintegrated particles of pre existent rocks, such as granite, gneiss, mica-slate and hornblende rocks, the origin of the native copper might be attributed to the deposition of the debris of the disintegrated veins of copper pyrites in the sand, which subsequently became indurated into sandstone, and was afterwards disrupted and fused at the juncture of the two rocks by the upheaval of intensely ignited and overflowing trap rocks, thrown up like lavas from beneath the solid crust of the earth. This theory was regarded as adequate to the explanation of the occasional existence of lumps of native copper in the amygdaloidal trap and the accompanying breccia. Thus far no regular vein of metallic copper was known or even believed to be probable.

In this state of scientific opinion it might have been hazardous to the reputation of any geologist, who was not prepared to demonstrate the fact, to declare his belief in the practicability of mining with advantage for *native copper*. This I was fully aware of, and in my first surveys on Lake Superior I took care to collect ample proofs of the existence not only of true veins of native copper, but also to prove the extent of the veins, and that they became richer as they descended into the rocks. The favorable situation of some of the veins which were in the beds of streams over hills or precipices, enabled me to effect this without being obliged to wait for the slow and expensive operations of mining; for, by tracing a vein down a steep slope and measuring the difference of level, it was easy to say, with certainty, what would be the nature of the vein at an equivalent perpendicular depth when opened by the miner's shaft. Owing to the

more ready disintegration of the substance of a vein than that of the solid ledges, the streams frequently wear their channels in the course of a vein, especially if the slope of the land should chance to direct the waters along that line. Hence it is obvious that many of the streams were likely to expose the surface or outcrops of veins in a linear direction. This was found to be the case in several instances, and advantage was taken of this circumstance to trace the linear extent of some of the veins, so as to prove that the deposites of copper were not mere *stock-werkes*, or short contemporaneous deposites in irregular fissures. Certain minerals were also observed to characterize true veins, and to form the leaders or central lines of the fissures in which the copper was deposited. It was also remarked that the prehnite which generally forms these leaders was impregnated with very small and almost microscopic crystals of native copper at the surface, and that the proportion of copper rapidly increased in this veinstone as it descended into the rock, and the veins soon contained lumps of solid copper of considerable size.

From data such as these the opinions which I published in 1844 were derived; and those opinions were confirmed by my renewed researches in 1845, and by the experience of the miners who have since carried on their operations on Keweenaw point.

It was feared by some geologists that the veins might run out, or that they would become poor; but, thus far, the metallic contents of the lodes have been found to increase in richness as they were penetrated by mining operations; and it seems to be ascertained that the true veins continue to enrich until they reach another kind of rock, when the nature of the contents of the vein changes. This has been proved at two of the mines, the only ones which have attained any considerable depth.

My first explorations on the mineral lands of the United States in Michigan were made in the summer of 1844, while in the employ of Hon. David Henshaw, who accompanied me to Keweenaw point for the purpose of examining the country for copper. The linear survey had not, at that time, reached any portion of the mineral lands, and Keweenaw point presented an unbroken wilderness; only a small party of miners, in the employ of the Lake Superior Mining Company, and an encampment of United States soldiers, having established themselves there.

The only houses which had been erected were the office of government mineral agency of General Walter Cunningham, at Porter's island, Copper Harbor, and a rude log-hut, built by Charles Gratiot, esq., at Eagle Harbor, for the accommodation of his party of explorers. Not a road or trail existed anywhere on the point, and the tangled growth of spruce and white cedar obstructed the banks of the streams and the coast, giving a most unpromising appearance to the country, and offering great difficulties in the exploration of those regions which were considered most likely to expose the metalliferous veins. Numerous pits had been sunk, at random, in the soil and rocks at Eagle Harbor, by the miners under the direction of Mr. Gratiot; but nothing considered worthy the attention of capitalists had been discovered, and the miners were about to leave the country. Mr. De Garmo Jones, of Detroit, had sent up Mr. C. C. Douglass to aid Mr. Gratiot in exploring the country, and he was associated with me in my labors, proving a very efficient assistant. Mr. Frederick W. Davis and Mr. Joseph S. Kendall accompanied me, and assisted in exploring the country for minerals.

It is well known that the results of my examination of the mineral lands on Keweenaw point were the establishment of the fact that *native copper and native silver* existed there *in regular veins, which could be advantageously wrought* by *mining operations*; and that, in consequence, the capitalists of the eastern States began the enterprises which have resulted in the demonstration of the practicability of mining profitably for copper and silver on Keweenaw point. I selected the best veins for the establishment of permanent works, collected and analyzed the ores, discovered the nature of all the minerals accompanying the copper and silver veins, and published a brief report of my researches.

In 1845 I was again sent to Lake Superior, and then explored other veins, and pointed out the superiority of the *metallic lodes* over that of the *ores of copper*—a result quite contrary to the general opinion of miners and geologists, but which has been most fully sustained by subsequent experience. As was anticipated by me, the green silicate and black oxide of copper at Copper Harbor soon gave out and was abandoned. The Boston and Pittsburg Mining Company transferred their miners from that place to the metallic copper lode, which I had surveyed in company with Mr. Whitney, at the cliff, on the southwestern branch of Eagle river. This mine is now well known as one of the wonders of the world, affording the largest masses of native copper which have ever been seen, and yielding a considerable amount of native silver. I again surveyed those veins I had explored in 1844, and advised the opening of a mine at a place which I named Copper Falls. Operations were forthwith commenced at this place, and a new company was formed by the division of the Lake Superior Mining Company. This mine is still in operation, and has given promising results. The Lake Superior Mining Company sold out their right to the veins at Eagle Harbor, opened mines on the borders of Eagle river in 1844, and continued their operations for some years at that place. They did not succeed in making their mine immediately profitable, owing to want of experience in the business, and the great difficulties and expenses they had to undergo in a wilderness where every article of supply was then very costly and had to be obtained from a great distance. It is now understood that regular mining operations will be resumed at that place, and it is hoped with better success.

It became my duty to condemn a great number of localities as of no value, and they have been mostly abandoned after some further explorations.

Soon after the publication of my first report, several scientific gentlemen and persons interested in geology visited the lake, verified my researches, and extended their observations to other parts of the country. In 1846, *speculations* in *mining stock* became prevalent in most of our cities, and many companies were formed with the idea of mining on Lake Superior. Locations were taken possession of at random, and reports, prepared by incompetent explorers—some of whom called themselves geologists—were spread all over the country. Stock-gambling became the rage, and the result, as might have been easily foreseen, was to injure the confidence of the people in all mining adventures, and especially in those of Lake Superior, the site of so many absurd speculations. Against this folly I used my utmost exertions, exposing the errors which I knew existed with regard to the supposed value of locations I knew to be worthless, and gave lectures for the purpose of correcting public

explained and exposing the absurdity of many of the popular schemes of mining; while I sustained the really valuable locations, and advised judicious and enterprising operations on well proved veins.

Experience has since proved that the views I then promulgated were correct, and since then a sane and proper economy has taken place in mining adventures on the lake. This result has been in a measure brought about by time and by a downfall in the mere speculations; while some of the companies having good mines have endeavored to proceed with their operations.

It is due to the country and to myself that this exposition of the facts should be published; for it should be known that mining on Lake Superior was not the result of chance, and that speculations in mining followed in the train of really good and proper adventures—an occurrence by no means confined to the business of mining.

In this report I shall contribute some of the most important observations that were made by me in my surveys of 1844, trusting thus to place them beyond the reach of any subsequent explorer who might set up claims to them. To those who have preceded me I shall endeavor to give full credit.

The island of Mackinaw has long been known to consist of a grayish white compact limestone, containing a few species of fossil shells and corals, which appear to belong to the upper part of the Niagara group of the silurian system, or the cliff limestone of Ohio. I obtained a few internal moulds of the fossil shell *pentamerus oblongus* and a *cyathophyllum* from the limestone of Mackinaw.

The same limestone constitutes the rocky basis of most of the islands in St. Mary's river; and some of them, the fossils, are more abundant. Thin beds of gypsum were also observed in the limestone, and large masses of it were found by Dr. Houghton on one of the islands near Mackinaw. On reaching the Sault Ste. Marie we came to the red and gray sandstone strata, which dip into the lake at an angle of 18°, and form by their basset edges the ledge over which the waters of Lake Superior discharge themselves into St. Mary's river. On this shelf of red sandstone are strewn myriads of large rounded blocks of primary and trappean rocks which were probably brought down the lake by the ice. These boulders break the current of the water into irregular rapids, and render some of the channels dangerous to boats which pass down from the lake.

On the shore, at an elevation of twenty feet above the present level of the waters of the lake, the ground is strewn with innumerable boulders of granite, sienite, gneiss, hornblende rock, porphyry, quartz, epidote rock, conglomerate and indurated red sandstone, nearly as hard as jasper. These boulders rest upon the soil, which is underlaid entirely by red and gray sandstone strata. They are erratic stones derived from far distant localities; and, if they were brought down the lake by ice, the water of the lake at the epoch of their deposition must have been more than twenty feet higher than it is now, and the outlet must have been some miles wider.

On examination of these boulders, and comparison of them with the rocks on Lake Superior, it is observed that many of them must have been removed from the interior of the country by the agency of rivers, for the coast of the lake does not present such rocks as are found among these boulders, though ledges of the same nature are found inland.

I suppose, then, that the ice of the rivers, raised by the spring freshets, bore many of these rocks from their beds, and deposited them at their mouths, on the lake coast, and that subsequently, by the ice forming on those shores, the rocks were again lifted and moved down the lake, the current transporting the ice with its load of rocks.* The current of the lake is so gentle, we must suppose that many seasons were required for the removal of these boulders from their native places to the Sault Ste. Marie, if this removal was effected by causes now in action. If we resort to the glacial agency of a more remote geological time, as required for the explanation of the phenomena before us, we shall have to conceive of Lake Superior as a large *mer de glace*, scooping out not only its bottom, but extending its ravages over the hills and mountains of the lake borders, or receiving by numerous lateral glaciers the tributes from the distant hills; but I am not sure that American geologists are prepared to accept the glacial theory, as adequate to account for the removal of drift boulders. Certainly the high northern latitude of Lake Superior will afford us ample ground for making the whole lake into a huge sea of ice, if the temperature of the middle States should be proved to have once allowed the formation of *glacier* ice hundreds of feet in thickness.†

It may be regarded as certain that the waters of Lake Superior occupied a much higher level in ancient times; for we observe not only three or four different terraces that formed the ancient shores of the lake—one forming after another, as the waters gradually subsided—but we have a still stronger proof of the action of the waves of the lake, in the erosion of caverns at Pictured Rocks, where the sandstone has been worn into spacious and elevated arches by the action of the surf and the grinding of pebbles driven by the waves. This will be more fully proved by observations which will be recorded further on in this report.

The red sandstone at the Sault Ste. Marie is soft, and it is easy to excavate a canal through it, so as to connect the navigable waters of the lake with those below the rapids. By means of a levelling instrument, I ascertained that the difference of level between the waters above and below the falls is between eighteen and twenty feet. I believe that a survey and plan for a canal have been made, but thus far no attempt to carry the project through has been made.

The only difficulty in making a ship canal at the place is, that there would be required for the protection of its entrance on the lake shore an extensive breakwater, capable of resisting the action of the ice and the batterings of the surf. This breakwater should be so constructed that the ice might slide over, instead of passing against, its walls.

If it should be found desirable to construct a railroad, instead of a canal, the ground will afford great advantages; for the sandstone strata form a nearly level bed, and the soil resting upon the rock is but a few feet in thickness, and in many places the rock is within a few inches of the surface and would form an unyielding bed for the track. Little or no excavation would be required in building a railroad, and the distance is less

* This theory, I find, was proposed by the *French Jesuit missionaries two hundred years ago.* Indeed, they seem to have anticipated the *glacio-aqueous theory of drift.*

† Sir John Richardson, who has recently returned from the arctic regions of this continent, informs me that *no glaciers exist in that frozen region;* and hence it is not probable that they ever did exist there, for the conditions required for the formation of glacier ice are not found in those regions.

than a mile. The railroad might perhaps run out upon a pier extending to water deep enough for shipping.

To facilitate transportation on the lake, some such improvement should be made.

Since my first visit to Lake Superior, the Sault Ste. Marie has rapidly become settled by traders and forwarding agents, and the town is now in a thriving condition. Formerly, the only business was Indian trade and the fisheries—most of the white fish sold in western States being caught and packed at the Sault.

At present, the forwarding of supplies to the miners and the transportation of copper add considerably to the business of the place; and some of the inhabitants are apprehensive that a ship canal would destroy their business of forwarding supplies, or in shipping copper. This idea, like the first popular prejudices against labor-saving machinery, is fallacious; for whatever improvement tends to afford facilities for travel to and from the lake, and to cheapen supplies, must immediately tend to increase the business at Sault Ste. Marie, and aid in settling the country. I trust, therefore, that those inhabitants who would be most directly benefited by the contemplated canal will not oppose an improvement whereby Lake Superior will be connected by direct navigation with the lower lakes, and thus with the ocean. It will be done sooner or later, and there is no reason why it should not be done now. It is due to those hardy pioneers who first opened this new mining region and brought forth part of its buried treasures, that a ready way should be prepared for their free communication with the more settled parts of the country.

Leaving the Sault Ste. Marie, we embark upon the waters of the great lake, sail for Keweenaw point, and begin our researches at Copper Harbor.

On reaching Copper Harbor, after a cursory examination of the trap rocks, conglomerate and sandstone, of that place, and of a series of specimens collected by General Walter Cunningham, the United States mineral agent, we took a boat and explored the coast to Eagle Harbor, stopping overnight at Agate Harbor on our way. This coast was found to consist of a coarse conglomerate rock, made up of rounded and smooth pebbles of porphyry, quartz, greenstone, epidote rock, hornblende rock, granite, sienite, agates, jasper, indurated slate and sandstone, all cemented together by finer particles of similar materials: on the immediate coast, the conglomerate rock cutting it nearly at right angles to its course, and running out under the waters of the lake. The sandstone and conglomerate rocks dip to the northwestward from 25° to 30°, and bear ample proofs of having been tilted up into their present inclined position by the trap rocks which protrude from beneath the strata a few rods further inland. At and near the line of junction of the two rocks, the trap is highly amygdaloidal, being frequently filled with agates and zeolites. Agate Harbor takes its name from the abundance of pebbles of agate which cover the shores where the amygdaloid has undergone disintegration; and the place has long been frequented by *voyageurs* for the purpose of obtaining specimens of them. After a cursory examination of this coast, we reached Eagle Harbor, where a party of miners, under the direction of Mr. Charles Gratiot, had passed the winter, and had made numerous explorations, in the hope of finding a workable vein of copper. They had sunk several shallow pits into the rocks, where pieces of copper had been found, and

had opened some of the prehnite and laumonite cupriferous veins, but seemed to have met with little encouragement.

Mr. C. C. Douglass had been sent by Mr. De Garmo Jones, of Detroit, to aid the miners in finding the copper veins, and was associated with me, performing much valuable service, for which he was prepared by previous excursions with Dr. Houghton, while he was State geologist of Michigan. We examined with care every locality where it was thought copper might be found, and described ten different veins which occur on the lands taken by the Lake Superior Mining Company; we also examined and described all the minerals brought in by the several explorers who were engaged in searching the country for mines. To the industry and perseverance of Mr. Douglass I am indebted for much information concerning the localities where viens of copper occur. Several of the smaller veins were examined by him alone, were reported to me, and were described as unworthy of further research; thus much time was saved.

Eagle harbor is a small bay, about a mile in length, and a little more than a third of a mile in width. It is deep enough at its entrance for the ordinary draught of schooners and steamboats to pass into it, and is capable of being rendered accessible to vessels of larger size, by blasting away the ledge forming the bar. The rocks are amygdaloidal trap, associated, as usual, with sandstone. On the south side of the bay fine red sandstone strata were observed, and the dip was found to be to the north-northwest 25°. Crystallized calcareous spar veins, from a few inches to more than a foot in width, were found, and in them were observed perfect crystals of analcime in its usual trapezohedral form. At the point on the west side of the harbor a vein of datholite and prehnite, containing abundant particles of native copper, was found. Large and perfect crystals of datholite, of a delicate pink color, were obtained at this place, and in some of them minute scales of copper were observed. A black mineral, looking like the scoria of a copper furnace, forms the principal veinstone at this point, and on chemical examination it was found to contain silex, oxide of iron, oxide of copper, and boracic acid. The outcrop of this vein is nearly on a level with the waters of the lake, so that it was not regarded as worthy of any further examination by mining. A few blasts were put in for the purpose of obtaining specimens of the minerals. On the shore, numerous pebbles were picked up, in which were found both native copper and silver; but no vein of these metals was found beneath or near it. A few rods east from the bay, on the lake shore, a wide vein of laumonite, full of strings and irregular pieces of native copper, was found, and good specimens were obtained. This vein was subsequently worked by the Eagle Harbor Company, who had purchased the lease of the Lake Superior Company; but they opened the vein directly into the lake by a trench, without any regular and systematic mining; and although they obtained a considerable quantity of laumonite, rich in copper, they injured the ground for mining, so that it has been abandoned.

A vein called, by Mr. Douglass, No. 1, on the Lake Superior Company's location, was examined by him and Mr. Davis. It is nearly two miles southeast from Eagle river, and is sixteen inches wide. It occupies the bed of a small stream, and is exposed for six or eight rods: its course, as determined by a pocket compass, south 15° east, north 15° west; and its dip is to the westward. Vein No. 2 is the one previously described at the point at Eagle Harbor. No. 3 was examined by Mr. Douglass, who states

that its course is north 15° west, south 15° east; and its dip was to the eastward. The width of the lode was six feet; and although no copper was found at the surface, small particles of it were observed in the rock thrown out of the pit which had been sunk in it. A little silver was also seen. This vein was regarded as of no value.

Vein No. 4 occupies the bed of a small stream, eighty rods east from Copper Falls. The surface of this vein was so covered by earth that it was difficult to examine it without the aid of miners. A small amount of native copper was seen in the veinstone.

No. 5 is the vein now known as the Copper Falls mine; it was first discovered by Messrs. Joseph Hempstead and C. C. Douglass, and was immediately visited and examined by me. The course of this vein was by compass north 26° west, south 26° east; and its dip was northward. It occupies and crosses the bed of a stream, and is fully exposed to view in the rocks at the falls. At the head of the falls the vein was six inches wide, and fifteen or twenty feet lower down the width had augmented to more than a foot, and in some places it was 18 inches wide. The veinstone was of prehnite and calcareous spar, and particles of copper were pretty thickly mixed with it, but were of minute size at the surface. At the bottom of the falls large lumps of copper, some half a pound in weight, were found; and, on blasting into the vein, the copper was observed to increase in quantity, so as to prevent our obtaining any large masses of the veinstone by the use of powder. In the wall rock, on both sides of the vein, globules of copper were observed pretty thickly implanted, and several string veins or feeders came into the main vein.

From all the ascertained conditions, it was thought this place would prove valuable for mining, and it was therefore recommended to the company to sink a shaft for the purpose of testing it. This was not done until the next season, when I made a minute resurvey of the location.

The rock containing this vein is a reddish amygdaloid, produced by the interfusion of a fine red sandstone and greenstone trap. A bed of sandstone dips in such a manner as to pass under a perpendicular shaft sunk at the mine.

Above Copper Falls we came to another bed of amygdaloid, dipping with the before-mentioned sandstone to the northwestward, and underlying it. A quarter of a mile further up there is another bed of sandstone, which also dips to the northwest 25°; then another bed of amygdaloid was seen; so that there are a series of alternating plates or beds of sandstone and amygdaloidal trap. Some of these trappean beds have the appearance of strata, though they are not really stratified in their intimate structure. The fine sandstone is curiously divided into rhombic prisms, and appears like brickwork irregularly laid up. The grain of this sandstone is fine; it is indurated by the influence of the trap rocks, and appears as if partially fused. Compact masses of it form good whetstones, and it has been used for that purpose by the miners.

Notwithstanding the pre existence of the sandstone, the trap rocks which burst through and between these strata have not given a metalliferous character to the stratified rock; and it is found that the veins either of copper or copper ore cease to be productive at the points where they traverse the sandstone, calcareous spar generally filling the crevice traversing that rock, while the copper disappears. These curious rela-

ions of veins to their including rocks I shall more particularly discuss in . subsequent part of this report.

Vein No. 6, situated at Sand Bay, was examined by Mr. Douglass and he miners. It was a foot wide at the surface, but it contained very little native copper, and was abandoned as worthless.

Vein No. 7 was also examined by him. It is exposed in the bed of a small stream immediately opposite the middle of Sand Bay, about half a mile from the shore. Its course, by compass, was north 20° west, south 20° east. Little copper occurs mixed with the veinstone; but one loose mass of pure copper, sixteen pounds weight, was found in the stream, and was presented to me by Mr. Gratiot.

Vein No. 8 is situated on Eagle river, about a mile from its mouth, and, for the distance of 1,800 feet in length, is exposed in the bed of the stream—a vein of prehnite, filled with particles of native copper and silver, being the leader. This vein or leader is from three to eight inches wide, and on each side of it, to a considerable distance, the amygdaloid is filled with globules of copper and silver, so as to form a lode of considerable richness. The course of the vein is north 32° west, south 32° east, by compass. On the west side of the river, where the vein approaches the bank, the amygdaloid is very rich in copper and silver, and there the first mining operations were commenced—a shaft having been sunk and a considerable quantity of the metalliferous rock extracted. Samples were blasted from the whole face of the cliff opposite the point where the shaft was directed to be sunk: 50 pounds of it were assayed by me, and the following results obtained:

		Per cent	Per ton.		Pure copper.	Silver.
	Lbs. oz.	*Lbs. oz.*	*Lbs.*		*Lbs.*	*Lbs.*
Coarse washed ore.....	8 13	17 9	350	Which contains—	220	3 8
Fine..... do.....	8 12	17 9	350		43	.6
	17 9	35 2	700		263	4.4

One ton of the rock, therefore, contains 263 pounds pure copper, and $4\frac{4}{10}$ pounds pure silver.—(See American Journal of Science, vol. xlix, No. 1; also, my report to the Lake Superior Copper Company, 1844 and 1845.)

Vein No. 9 was examined by Mr. Douglass, who describes it as situated half a mile from vein No. 1, and as being from two to four inches wide. It contains some native copper.

Vein No. 10, also described by him, crosses Eagle river, a little further up than vein No. 8; but I have not been able to find it, owing, perhaps, to the covering of boulders and gravel in the river's bed.

These veins were all explored as far as was then practicable. Specimens were obtained and submitted to chemical examination by me, and a few of the veins were considered worthy of mining operations—that of Eagle river (No. 8) and of Copper Falls (No. 5) being the best then discovered. Specimens were brought by Mr. Jacobs, one of the explorers of the Lake Superior Company, from the cliff on the west branch of Eagle river; but they were poor when compared with those subsequently obtained by mining at that important place.

In 1845 I was sent to re-examine the locations of the Lake Superior

Company, and was employed to survey the cliff vein for the Pittsburg and Isle Royale Company. Mr. J. D. Whitney was associated with me in the latter survey, and we examined the latter vein in company. The measurements and plans were made, and the samples of the ores taken assayed by me, and the report thereon presented to the company.

New surveys were made with great care of the Copper Falls vein and the Eagle river mines, and numerous analyses and assays of the minerals were made at the mines, and after my return to Boston.—(See my report for 1845.)

Organization of the parties for the geological survey in 1847.

It was thought advisable in the selection of my assistants to choose gentlemen who had already some experience on Lake Superior. I therefore appointed Professor John Locke, of Cincinnati, Ohio, and Mr. J. D. Whitney, of Northampton, Massachusetts, both of whom had been employed in mining surveys on the shores of the lake. Dr. Locke was also already distinguished as a magnetic observer and as a geologist, and was, therefore, especially qualified for the duties assigned to him. Mr. Whitney had been for some years my pupil, and had assisted me in a previous geological survey.

The other members of my corps were—

Dr. William F. Channing, of Boston, sub-agent;

Mr. Joseph Peabody, of Salem, sub-agent;

Mr. J. H. Mullet, of Detroit, surveyor;

Mr. George O. Barnes, of Plymouth; Mr. William R. Bernard, of Missouri, assistant sub-agents;

Mr. John Locke, of Maine; Mr. C. A. Joy, of New York; Mr. G. J. Dickenson, of Boston; Mr. George E. Smith, of Illinois; Mr. James McIntyre, of Maine, packmen for instruments, &c.

Mr. Joy was subsequently employed as clerk for the party.

Mr. Peabody wishing to improve himself in the science of geology by being with me constantly, and intending to leave a vacancy to be filled by Mr. J. W. Foster, who was desirous of being associated with us, generously resigned his place of sub-agent in favor of Mr. Foster, who was employed with the understanding that he would prepare sketches of scenery and aid in the drawing of sectional views.

Three parties of explorers were organized and received instructions from me as to their duties, and then each party was sent to make the explorations required.

Previous to this dispersion, I was desirous of affording to every member of our corps an opportunity of inspecting the mines which had previously been surveyed by me, in order to impress on the young men the importance of not disregarding veins that are exposed on the surface of the earth, which, though not prepossessing in their appearance, often lead to rich deposites of native copper, as was demonstrated at the Copper Falls, Lake Superior, and Boston and Pittsburg Company's mines. At the same time an opportunity was afforded to Dr. Locke of making his magnetic experiments in and around the mines.

After this preparation, the several parties separated. Dr. Locke, with a suitable corps of sub-agents and packmen, was sent to explore the coast to Chocolate river, and then to examine two ranges of townships (range

and range 26) between the mouth of Chocolate river and Lake Michi-
. A copy of his instructions is hereto appended, (document A.)
Mr. Whitney, with a picked corps of voyageurs and two assistant sub-
nts and a packman for instruments, was sent to the Ontonagon river,
l was instructed to explore the country between that and the Montreal
er; also, to send one of his party with the linear surveyors who were
work running the township lines near the boundary of Wisconsin and
chigan. His instructions are annexed to his report. (See document B.)
The third party, under my immediate direction, made a rapid tour
und the northern shores of the lake for the purpose of a general recon-
ssance of the country, and in order to make a few astronomical meas-
ments, and then we were left by the steamboat on Isle Royale, where
oposed to make a more minute exploration for mines and minerals,
l determine the geology of the island. This was effected in as rapid
anner as circumstances would permit—a thorough examination of the
logy of the entire island having been effected, all the accessible veins
lored, and numerous astronomical observations made on different
nts of the island. A number of cases of minerals were collected, and
ry mine was examined. A section was surveyed across the island by
srs. Ransom, Peabody, Foster, and myself, and my plan was neatly
ied by Mr. Foster. After the completion of this survey, we were de-
ed three weeks awaiting the arrival of a vessel to take us back to
weenaw point, where I proposed to make a more thorough examina-
l of the mines and to collect a supply of minerals, and, if possible,
omplete the survey of the entire peninsula. This I was enabled to
omplish in part only, on account of the lateness of the season. All
working mines were visited, and many of the abandoned ones were
examined, and a larger collection of fine specimens of the ores and
nerals were obtained for the use of the government.
n the mean time, the surveys of the eastern district by Drs. Locke and
anning, and of the western district by Mr. Whitney and his party,
re in progress, and the result of all our labors was expected to prove
hly satisfactory.
Hastening home in order to arrive in time to make out my first synop-
, as required by my instructions, to be presented by the middle of No-
nber, I prepared that report in season, and forwarded it to the Treasury
partment, and it was printed in the report of the Land Office—a
opsis intended merely to give an account of the progress of the
vey; hence all details were reserved for my final report, which I was
tructed to prepare on the completion of the survey.

Organization of the parties for the survey in 1848.

During the winter of 1847 I was employed in making analyses of the
s and minerals collected during the summer's field-work, and my as-
ants were instructed to prepare the materials for their reports on their
eral districts. Mr. Whitney was employed in my laboratory part of
winter in the analysis of some new minerals which had been discov-
d by me; and Mr. Barnes analyzed some specimens of the copper ores
l some of the minerals found in the native copper veins.
n the spring of 1848 arrangements were made for the continuance of
survey. Dr. Locke was detached, by orders of the Secretary of the

Treasury, as a magnetic surveyor, in accordance with my request, and a vacancy thus made in the assistants' corps was filled by my promotion of Mr. J. W. Foster to the place of assistant geologist. Mr. J. D. Whitney was still retained as an assistant geologist. Mr. Samuel W. Hill, of Michigan, had urgently desired the place of surveyor; and since Mr. Mullet's health did not permit him to go with us, I appointed Mr. Hill in his place. Dr. Walcott Gibbs, of New York, was appointed sub-agent in the place of Dr. Channing, who, on account of other engagements, had resigned.

My assistant sub-agents were: Mr. G. J. Dickenson, Mr. James McIntyre, and Mr. George O. Barnes; Mr. C. A Joy was employed as clerk, and Mr. A. W. Thayer as a packman for instruments. Mr. William Schlatter, whom we met at Copper Harbor, was temporarily employed as draughtsman, and Mr. Joseph S. Kendall as observer of the stationary barometer at Copper Harbor.

Four parties were ultimately formed from this corps:

The first party assisted me in the survey of Keweenaw point. This party consisted of Messrs. J. W. Foster, S. W. Hill, G. O. Barnes, A. W. Thayer, and myself.

The second party surveyed from the Ontonagon river to Keweenaw point. This party was made up by the association of Mr. J. D. Whitney, Dr. Walcott Gibbs, and Mr. C. A. Joy.

The third party explored the townships in the interior of Isle Royale. This party consisted of Messrs. G. J. Dickenson and James McIntyre.

The fourth party was made by sending my assistant, Mr. J. W. Foster, and surveyor, Mr. S. W. Hill, together, to explore the Menomonee river to Green Bay.

The results of the labors of the several parties will be given in the following reports; each assistant being required by me to present an account of all he had done, and to send in his maps, drawings, and illustrations. I send all the documents I have received. I regret to find that they are very incomplete, and that some of the statements in them are incorrect. I shall therefore make no attempt to incorporate any part of their reports, or to present any generalizations on any data given in them; choosing to limit myself to my personal observations and discoveries, in order to avoid any misunderstanding or possible misrepresentation.

I regret that I have not been allowed to keep the township plats of a portion of the country I have examined, which would then have been incorporated into my geological map, so as to have included the whole of Keweenaw bay, and some other places. All the township plats I had, have been reduced to proper geological maps by my assistant, Richard Cropley, esq., who has executed this work in an artistic manner. I present the geological maps of Isle Royale and Keweenaw point, both of which were drawn and colored by him. These maps represent the limits of the mineral lands more accurately than any description of the localities could be made to express; for the rocks pay no attention to township lines in their irregular course. The position of every mine is also marked upon them, and the courses of the most distinct veins are represented by colored lines, with arrows showing their dip, as well as that of the strata of the adjacent rocks. These maps are to be engraved to accompany this report, as are also the plans and sections of the mines I have surveyed.

Description of the trap rocks of Keweenaw point.

Trap rocks are composed chiefly of aggregated crystals and fine particles of hornblende and felspar, mixed with oxide of iron, and various accidental minerals, such as commonly occur associated with and are mixed more or less with them. These accidental minerals are generally the various zeolites, chlorite and calcareous spar. Their presence is not essential to the composition of the rock, which is, as before stated, composed of the minerals hornblende and felspar; but they are so commonly found mixed with it, that they should be regarded as the usual accompaniments, and they often most readily enable us to decide at the first glance the nature of the rock.

Trap rocks are regarded by all geologists as of igneous origin, some maintaining that they originate from the molten interior of the earth, and are formed from the primary metallic elements of the planet; while others regard them as the fused lower rocks, and as being derived from the strata which overlie the igneous matter in the earth's interior.

Whatever may be the views of geologists with regard to the particular origin of the materials, all agree that trap rocks, like the lavas of volcanoes, were thrown up from beneath the solid crust of the globe in a state of igneous fusion. This is most fully proved by the effects they have produced upon the strata through or between which they have found egress; and also by the structure, composition, and mineral contents of the trap rocks themselves. Instead of bursting out in circular spaces or by cylindrical chimneys, like the lava eruptions of modern volcanoes, the trappean rocks were intruded through linear chasms or fractures in the superincumbent rocks, which they not unfrequently have overflowed, so as to rest unconformably on their strata, appearing as overlying masses or as beds in the strata. They are observed on Keweenaw point, as had been also observed in Nova Scotia, New Jersey, and Connecticut, passing between the strata of red sandstone, and forming a large bow or crescent, the curvature or arch being directed towards the NNW., while the general direction or *trende* of the trap bed is ENE. and WSW. This is also the case in Nova Scotia, and is represented in the geological map of that province published by Mr. F. Alger and myself in 1828. It is interesting to observe a perfect parallelism in the lines of upheaval of those rocks, so remotely separated from each other, yet obeying the same general laws of disruption, and producing the same effects on the rocks which they traverse. On Keweenaw point the curve of *trende* of the trap rocks forms the arc of a circle, the radius of which is about thirty-six miles in length. The width of the belt of this rock is three miles in its narrowest part, and seven miles in its widest, the average width being five miles. It underlies seven townships, or, more exactly, 217 sections, between Portage lake and the extremity of the promontory. This is included between ranges 27 and 34½ west, and townships 27 to 34. The face of the country is broken, hilly, and irregular, numerous streams intersecting the surface. The soil is of excellent quality, warm and fertile, as trappean soils generally are, and is covered with a thick growth of hard wood forest trees, mixed with some soft wood. The forests are more open than those on the adjacent sandstone rocks, and the timber is more thrifty.

Most of the locations which were originally made on Keweenaw point

were on this band of trap rock, information having been obtained respecting its limits, and the fact stated that most of the copper mines are found in this rock. It was found very easy to determine the boundaries of the trap and sandstone, for the exposure of the rocks is complete at the end of the point and at Portage lake, so that, by measuring its width at these points, the position of it was determined there. Then, by searching the boundaries inland, the curvature of the band was readily ascertained. This I had ascertained from the researches made and information obtained on my first visit in 1844; but, during the survey, the whole district was traversed in order to test the correctness of the views then entertained. It has now been proved along the whole band from Portage lake to the extremity of the point, and a portion of the belt has been traced towards the Ontonagon river by my assistants. When the linear and geological survey under the direction of the late Dr. Houghton was made on this point, the portion of the trappean belt was ascertained with considerable precision, and was subsequently represented on the map of the country by Messrs. Burt and Hubbard in 1846. On that map, the positions of mines that have been opened at my advice in 1844 are also represented.

Sandstone and conglomerate of Keweenaw point.

The red sandstone and conglomerate rocks of Keweenaw point existed there anterior to the elevation of the trap rocks, and were produced by the deposition of fine sand and pebbles, derived from pre-existent primary rocks—such as granite, gneiss, or mica slate. Porphyry furnished a large proportion of the debris; but it is doubtful whether it is not a metamorphic rock, resulting from the semifusion of the finer materials of sandstone. It is evident at once, from inspection of the pebbles of the conglomerate, that they have been ground into their present shape by long attrition under water, or upon some ancient shore. They are oval and rounded, and are of various magnitudes, from that of a buck-shot to the size of a man's head. They originated from some nether rock, or were transported to their present location by drift agencies—this locality not exhibiting any rock they could have been derived from, in place. If they were transported boulders, like those of the more recent drift, they would seem to indicate the existence of ice immediately after the coal era—an opinion difficult to establish, it being counter-indicated by the fossils of that epoch.

There is no reason to believe that igneous agencies had anything to do with the origin of the pebbles of the conglomerate, for they bear ample proofs of their having been rounded by the action of water. From the circumstance that the conglomerate borders the trappean rocks, it is supposed that an ancient shore may have existed along that line, or that, during the upheaval of the trap and before the materials of the sandstone were indurated into masses, the reflux of the water may have carried away the fine sand into deeper water, and left the pebbles near the uprising trap. It is certain that the finer sandstone is more remote from the trap than the conglomerate is, and that it is less uplifted and inclined as it recedes from the trap band. Thus, at and near the junction of the two rocks, the strata dip 25° or 30°, while remote from it the sandstone strata are horizontal, or only slightly waved. Sandstone was certainly depos-

ited in water; for the ripple marks are well preserved, and record this fact in an absolute manner, for we at once recognise the well-known action of water on sand. By pressure and heat the materials of a loose, shifting sand became converted into solid sandstone, the layers of sand forming the different strata. At first, the whole must have been in horizontal or nearly horizontal layers; for water necessarily deposites mechanical sediment in this manner, and the only slopes of deposition would be on the shores, where a very moderate inclination would take place, but much less than we find it to be where the strata have been disturbed by the trap rocks which caused the elevation of the sandstone along the line of its disruption.

Anterior to my researches, the red sandstones of Lake Superior were supposed to be the old red, and subsequently the opinion that they belonged to the Potsdam, New York, series, gained ground; but, from the facts that the mineral composition, associations, and contents were identical with the sandstones of Nova Scotia, Connecticut, Massachusetts, and New Jersey, and that the disturbing agency which moved them was in the same direction, and produced similar if not identical results, I was disposed to regard those rocks as of the same age, or as of the new red sandstone series. This idea has been confirmed by researches made during the survey, and mainly by the discovery of a tract of limestone in the midst of the sandstone of Keweenaw point, near the Anse—a discovery due to Mr. C. F. Merion, one of the linear deputy surveyors. This limestone was visited by my assistant and sub-agents, and a fragment of a *pentamerus oblongus* was obtained, which leads us to the belief that this limestone is an upper member of Niagara, New York, group. The strata lines of the limestone dipping, according to Mr. Whitney, 30°, proves that the sandstone is not so old as the limestone, but was deposited around it. This would prove absolutely that the sandstone of Keweenaw point is not of the Potsdam series, and is either the old or the new red. Now, since the old red sandstone is generally rich in fossil shells, and no fossils have thus far been found in this sandstone—they being also rare in the new red series—the mineralogical resemblance and mineral contents, as also geological disturbance, all coincide to favor the idea that it is the new red, or that system of sandstones which is regarded as such in New England.

This question is one that has been agitated for several years; and I should have been able, the past summer, to have settled it to full demonstration, had not my field-work been interfered with, so as to prevent my completion of the work as was originally projected.

Changes which the sandstones have undergone by the action of trap rocks.

It is obvious that a mass of molten rocks, thrown up through sedimentary strata, must have excited a powerful influence on the materials and condition of the sediment.

We find that a chemical combination of the materials of the sandstone took place with those of the trap rocks at the line of junction, and a vesicular rock called *amygdaloid* resulted from this action; while further from the trap a *breccia* or *trap-tuff*, consisting of broken pieces of amygdaloid and sandstone, is found. Sometimes, instead of being broken into fragments and converted into a breccia, we find the sandstone indurated into a flinty red rock resembling jasper, though not so fine in texture. This

metamorphic change in the sandstone rocks is particularly noticed at and near its junction with porphyritic trap near Mount Houghton and Bohemian mountain, and on the coast, township 58, range 28, sections 25 and 26, where the jasper-like rock forms bold cliffs projecting into the lake. This rock in some places passes into a distinct porphyry, and appears to have derived its felspar from the adjacent porphyritic trap. In some instances it seems to have been entirely fused and thrown up like a porphyry dike. The same phenomena were previously noticed by me on the eastern coast of the State of Maine, where, at Seward's Neck, in Cobscook bay, the sandstone is changed distinctly into porphyry, and has all the appearance of having undergone entire fusion or softening into a paste by the action of heat. It is supposed by some advocates of the metamorphic origin of all hypogene rocks that the trap rocks are merely melted sandstones. If such is their origin, the alkalies and magnesia which they contain must have been added to the original materials of the sandstone during its fusion. There is no difficulty in conceiving of the sublimation of potash and soda, which we know are volatile at a high temperature; but magnesia being one of the most fixed or non-volatile substances known, while none of its combinations render it volatile in the slightest degree, we are at a loss how to account for its introduction into seperincumbent rocks by sublimation, and suppose its introduction must always have resulted from direct contact with the materials with which it is combined.

If the silurian limestone of Keweenaw point underlies the sandstone, it is possible that its magnesia may have been derived from the same source as that in the trappean rocks; for it is supposed by geologists that the magnesian limestones were originally derived from shells and corals, and by some chemical cause have been subsequently charged with carbonate of magnesia.

In favor of the idea of the existence of a fossiliferous limestone beneath the new red sandstone of Keweenaw point, we may mention the fact that a cast of what appears to have been an orthocera was found in the breccia of amygdaloid and altered limestones at the Copper Falls mines. May it not have been torn from a subjacent bed of limestone by the agency of the intruded trap rocks? We know that the trap dikes and granite veins in other places have brought up with them fragments of the rocks through which they passed on their way to the surface; and I would suggest this view as the most probable explanation of the presence of the fossil cast in question in a rock of igneous origin.

Between the sandstone and trap there is generally a mass of broken pieces of indurated sandstone, more or less vesicular, scoria of fused trap and sandstone, amygdaloidal and compact trap, porphyry and occasional (accidentally present) pebbles of other rocks. These materials form, when re-cemented by heat, a rock known under the name of *trap-tuff* or breccia. The fragments of rocks composing it generally have their angles of fracture more or less distinctly preserved; but sometimes they are partially rounded by the action of heat, and by the mechanical abrasion arising from the motion of the waters beneath which they were deposited. Thus by insensible gradations the breccia may pass into a species of conglomerate; but it is not to be confounded with the conglomerate rocks of the sandstone series, which are evidently more ancient, or were present anterior to the period of the intrusion of the trap rocks. The trap breccias

:cupy in some places, as at Eagle river, a considerable space between ıe sandstones and amygdaloid, and have been mistaken for the conglom-ate of the neighboring sandstones.

Along the line of junction of the trap rocks and sandstone, the trap be-omes vesicular or amygdaloidal, and the spheroidal cavities are generally lled with chlorite, calcareous spar, agate, laumonite and pectolite, in oncretions varying in size from that of a pepper-corn to that of a musket all. The chlorite appears generally to line the cavities in the amygda-id, and to have been first deposited. Calcareous spar or some zeolite agate was then deposited, filling the cavity, so that where the rock is oken and the spherules are exposed, they appear like green balls, their ırface being covered with chlorite. At the Lake Superior Company's ines, it was observed that when a cavity in the amygdaloid was filled ith chlorite, a granule of copper was almost invariably found in its centre. ı another portion of the amygdaloid, near the copper vein, the cavities ere filled with pure copper or silver, or with both these metals.

It is difficult, if not impossible, in the present state of science, to account r these phenomena, either by igneous agency or by infiltration from an ueous solution. The rock presents in its general aspect the appearance a slag, from which the copper had not been separated. The sole of an d reverbatory refining copper furnace resembles very much this rock; ıt still, on minute mineralogical inspection, the chemist or mineralogist ill observe that certain conditions existed in the copper-bearing amyg-loid, which are not reconcilable with the idea of its having been charged ith copper by sublimation of the metal, or even the entanglement of it mechanical means. It would be easy to make a theory which would emingly cover some of the facts, but it is more difficult with the speci-ens in hand to believe in it; for any one who is deeply versed in the inciples of science, and who is aware of the facts and their meaning, es difficulties that would not be apparent to an unqualified observer or lf-educated geologist. To one who is aware of the significance of the mplicated phenomena presented in these rocks, and the difficulty of ex-aining them by any known principles of science, a crude theory or hy-othesis seems an impertinence. He prefers to allow the facts to remain nexplained, rather than bedim his vision by the colored glasses of theory, ıd be thus led to false conclusions. I am confident that, in the present ate of science, no explanation can be given fully accounting for the asso-ation of minerals in these trap rocks, which could not be broken up by ı exhibition of other facts obtained on the same spot.

I make these remarks that they may serve as a salutary caution to those ho may desire to generalize phenomena which will not admit of it. It better for the present to arrange our facts in order, and to wait until eir relations can be better appreciated.

I value more discrepant facts than a general theory—holding that hasty neralizations have done much to obscure the vision of the scientific orld; while a new fact, as yet inexplicable, may be a thread leading rough the labyrinth of many complicated series of phenomena.

Nature and origin of the veins in the trap rocks of Lake Superior.

From what I have above stated, the reader is doubtless prepared to eet with an account of some complicated phenomena; and he will now

be gratified, perhaps, in the contemplation of a series of facts altogether new in practical geology, viz: the occurrence of veins of solid metallic copper admixed with native silver, and yet not alloyed with it. There are, also, most curious and inexplicable facts concerning the relations of the associated minerals containing or contained in copper. By reference to the catalogue of specimens of minerals I have collected for the use of the government, the reader will see that most, if not all, of the facts to which I shall call his attention are represented by those specimens.

Nature of veins.

Veins are fissures in the rocks filled with other minerals; contemporaneous veins are those which originated with the rock and are of the same age. They are distinguished by their running out either in length or depth, and are rarely valuable as depositaries of metalliferous ores. To this class of veins belong the *stock-werkes* of the German miners.

True veins generally traverse the strata when they occur in a stratified rock, and form, with the line of strike of the strata, a considerable angle. This class of veins is found to be more regular than those running parallel to the layers of stratified rocks, and have most frequently well-defined walls, often incrusted with layers of veinstone, prehnite, quartz, calcareous spar, or some other of the associated minerals—this margin being called *saalbandes* by the German miners. The fissure is filled with veinstones of various kinds and with the metalliferous or metallic matters, constituting, with the accompanying minerals, the *lode*. Sometimes the vein at the surface consists entirely of prehnite, containing only minute specks of copper within the crystals, or very sparsely scattered through the massive prehnite. These veins often lead to solid metallic copper, and the veinstone gives place to that metal.

On removing the prehnite attached to the masses of pure copper, the copper is found to be impressed with the forms of its crystals, showing that the copper was either fluid at the time it was brought in contact with the prehnite walls, or that it was deposited upon them from some solution of the metal, or by condensation of its sublimed vapor; both of these hypotheses are, however, objectionable.

The surface of the solid copper is also impressed by crystals of calcareous spar, quartz, analcine, datholite, and by most of the minerals which occur on the sides of the vein. We also observe that fine brilliant scales of pure copper exist in the interior of all these minerals, even in the perfectly formed crystals. It is obvious, therefore, that copper was present in its metallic state at the time when the minerals in the veins were formed; while it is obvious, from what I have previously stated, that there was a subsequent filling of the vein by metallic copper introduced by some means not yet satisfactorily ascertained.

It has been supposed by some geologists that the contents of the veins were introduced by galvanic segregation, an hypothesis likewise open to many objections. In the first place, we would ask, From what was the copper segregated? and if it was derived from disseminated particles in the rocks, in what state did it traverse them and concentrate in the veins? Again: How can we conceive of a battery formed of the sandstone and trap rocks to have been formed so as to make the veins their poles? If the rocks were galvanic at one time, we ought, as these rela-

to each other are still the same, to find a galvanic current in them even though it may have diminished in strength since the rocks be- cold. There is magnetism, as is very obvious, in all these veins, polarization in the walls, which form the terminations of the masses ip; but we have as yet no proofs of a galvanic current in them. It ny intention to have tested this question most thoroughly during ast summer, but my field-work was interrupted by orders of the rtment of the Interior. More may be learned of the laws that pro- l the deposition of copper and silver in these mines by a prolonged at chosen places, than by hastily running over the country with *fectation of diligence*, and without any correct views. I was in , therefore, to have been allowed time for these important investiga- ; and after properly instructing my assistants, to have left to them eremony of visiting those townships where the nature of the geology been sufficiently proved to render it unimportant for me to visit them rson. It is obvious to geologists familiar with geological surveys, from coast exposures, and those in the beds of rivers and upon hill- , where the rocks are best determined, the positions of the inland s can be most satisfactorily ascertained. Still, in order to obey in- tions, we have to visit all the townships, even though they are ed by soil and swamps; and if no additional facts in the geology are tained, it is possible we may add something to our knowledge of the raphy. *In the mineral lands, however, I chose always to go myself gh every township along the probable line of mineral deposites.* This ll been done, and all the facts which can be obtained in the present of the country are learned, so far as concerns the geology and mine- y and mines of Keweenaw point and of Isle Royale.

turning from this digression, I would next describe another class of which run parallel to the direction of the trap range, and lie be- n it and the sandstones, in amygdaloidal rock or in epidote. These , or beds, as they are also called, are not generally regarded as per- nt for mining purposes, and yet they are often sufficiently powerful ich to render them worthy of attention. The miner, I know, looks em with distrust, and is unwilling to lay out expensive work on ; but, so far as they have been opened in one or two of the Ontona- ocations, they have given promising results, insomuch that I would mend the thorough examination of one of those beds by regular g operations, so as to decide on their permanency.

Journal kept on the Geological Survey in 1847.

ne 3.—I sent a party of assistants and sub-agents to Detroit to obtain ies for the survey, and there to await the arrival of the other mem- of the corps.

. Locke, one of the assistants, was at Washington, and was requested n the party at Detroit on the 10th of June.

ne 7.—I left Boston with the remainder of the corps, and joined the at Detroit, to which place I had requested the Secretary of the Trea- to send the funds required.

ne 13.—The party was sent from Detroit to the Sault Ste. Marie. I ned in Detroit awaiting the arrival of a draft on the Treasury De-

partment, and for copies of township plats and maps from the surveyor general's office.

June 15.—I went to Ann Arbor to examine the specimens collected by the late Dr. Houghton.

June 16.—I received a letter from Mr. Young, Commissioner of the General Land Office at Washington, informing me that my letter to the Secretary of the Treasury, asking for a remittance, had been attended to.

June 19.—I received a letter from the Commissioner of the General Land Office, authorizing me to draw upon the treasury of the United States for $2,500.

June 21.—Negotiated the draft with C. C. Trowbridge, esq. Deposited in his hands for safe keeping $2,000, and took $500 in silver for part payment to my boatmen. Left Detroit for Mackinaw and the Sault Ste. Marie; at the latter place we found the advanced party waiting for a passage to Copper Harbor.

June 24.—Left the Sault Ste. Marie for Copper Harbor.

June 25.—Reached Grand Island, where, during a short stay at noon, I took a meridional altitude of the sun to determine the latitude of the place, which was found to be 46° 29½′. At noon, barometer eight feet above the level of the lake stood at 29.502, temperature 78° Fahrenheit. Temperature of the lake far out, is + 2½° C. = 36½° Fahrenheit. Temperature of the air at same time, + 9° C. = 48° Fahrenheit. Time of the observation, 5 p. m. Dr. Locke and myself measured the height of the mural cliffs at the Pictured Rocks, while the steamboat was passing by them, and found them to be 175 feet high.

June 26.—We reached Copper Harbor.

June 27.—Went to Fort Wilkins—saw ordnance sergeant Wright—took up quarters there, promising to obtain orders from the Quartermaster General for permission to occupy them. Took time and variation observations by altitude and amplitude of the sun. Watch, originally set to Boston time, was found to be 1*h*. 11*m*. 23*s*. fast for mean time of Copper Harbor. Rate of watch determined subsequently, 13″ loss per diem—hence the difference in time between Boston and Copper Harbor is 1*h*. 7*m*. 3*s*.

Variation (declination) of the magnetic needle, by amplitude, found to be 5° 10′ east.

June 28.—Wrote to Washington—arranged and adjusted our instruments—selected our materials, and divided the corps into three surveying parties.

June 29.—Went to Eagle river with my whole corps for the purpose of instructing the young men in the business of mining, and to prepare them for observations on veins they might discover in the districts they would be sent to explore. These mines had all been previously surveyed by me, and afforded admirable opportunities for showing the progressive enriching of veins as they descend into the rocks. At the same time Dr. Locke and Mr. Mullet, my surveyor, had opportunities for making a series of interesting observations on the magnetism of the trap rocks, and of the disturbance of the magnetic needle near the veins.

June 30.—Examined the Lake Superior Company's mines, which are not in operation at this time; but the superintendent awaits orders from the trustees of the company. I descended into every shaft that had been sunk, and examined every level with as much care as was practicable,

and searched the rocks and the vein for the purpose of learning the state of the mine. It appears that shaft No. 2, passed into the western side of the vein, was very rich in copper and silver at the surface, where it immediately bordered upon the central vein or leader, and impoverished as it left it in descending. After working for a time in the barren rock, the miners sent off a level towards the river, with the intention of striking the vein under the stream, but, to their great surprise, opened into a deep and wide ravine, or ancient channel of the river, filled with great masses of copper, lumps of copper and silver mixed, small globules of pure silver, all rounded and worn by the action of running water, and mixed with sand, gravel, and water-worn pebbles. A single mass of silver was obtained from this ravine which weighed 6$\frac{1}{16}$ lbs., and was worth $130. It is now in the cabinet of the United States mint in Philadelphia. Masses of copper varying in weight from a few ounces to more than a thousand pounds were also obtained, and were exported to France and sold. The miners called the ravine a cavern, and did not fully understand its nature and origin. To me it was immediately apparent that the water of the river had, in ancient times, cut away the more easily decomposable veinstone, and had left the copper and silver, which, on account of their high specific gravity, sank to the bottom, while the lighter earthy particles were washed away. The copper was worn by the abrasion of sand and boulders of rocks, and was left in the ravine with the large boulders, which, obstructing the running water, and entangling the sand washed down the stream, caused the gradual filling up of this trench. The river, turned aside by this obtruction, wore its way into the rocks, and formed a new channel. It is probable that there was formerly a water-fall at this place, and that the rocks have gradually been worn down to the present level, the falls disappearing on this account. Such is the probable origin of this ravine; and it appears that the river had done the first mining, directly in the vein. No one could have known in advance that such an opening would have been found, so far beneath the present bed of the river, but it was certainly unfortunate for the mines that a level should have been sent off so near the surface. It was done contrary to my advice. Some good has resulted from it, for the true position of the vein has been demonstrated by it, as the bottom of the ravine exposes a green veinstone, mixed with calcareous spar, in which there are globules and pieces of copper and silver, and it is highly probable that, if proper mining operations are carried on here, a rich lode may yet be won.

After examining into the condition of these mines, I made a series of magnetic observations around them by means of a solar compass.

The declination of the magnetic needle was found to be—

At the mines, 6½° E.
N. E. side of the river, 2½° E.
At shaft No. 2, 2½° E.
Between shafts 1 and 2, 1° W.
At the office, a few hundred yards west of the mine, 7° E.

The course of the vein in shaft No. 2 was N. 30° W.

Dip of the wall rock in ravine, N. E. 70°.

Barometrical observations at the mouth of Eagle river, 5½ feet above the surface of lake.

5½ feet above surface of lake, 9h. 25m., 29.450, T. 17° C., t. 16° C.

At Lake Superior Copper Co.'s office, 10h. 30m., 29.210, T. 22° C., t. 22° C.

Height by barometrical observation, 256 feet; height by previous levelling, 246.14 feet.

July 1.—Visited the Cliff mine, belonging to the Boston and Pittsburg Mining Company, situated on the southwest branch of Eagle river, about three miles west from the office of the Lake Superior Copper Company. This mine I surveyed, anterior to its being wrought, in the summer of 1845, in company with Mr. J. D. Whitney.

Barometrical observations at office of the Boston and Pittsburg Co.—

12½ p. m., B. 29.13, T. 24° C., t. 24½° C.

4½ p. m., B. 29.10, T. 25° C., t. 24½° C.

These observations were taken to determine the elevation of that spot, which is found by calculation to be 404 feet above Lake Superior.

At this mine there are thirteen houses, most of which are now occupied by people attached to the mines. One of them contains a steam-engine and set of dry stamps, which were put up, and after a short time proved to be useless.

The Cliff mine is one of the most remarkable known, for the enormous masses of native copper it contains. One of the masses, now got out, is estimated at 50 tons weight. It is cut by means of steel chisels, driven by blows of a heavy sledge-hammer—one man holding the chisel, while the other strikes with the sledge; a groove is mortised out across the mass of copper, and then a series of ribbons of it, about a quarter of an inch in thickness, are cut out, until the channel thus mortised divides the mass. They divide the copper into masses of about a ton or a ton and a half in weight—the cost of cutting it being now $10 per square foot of cut surface, measured on one side of the mortise. The copper is perfectly malleable and ductile, and is very tough. During the past summer, 44 copper rocks, weighing 61,995 lbs., and 77 barrels, weighing 42,356 lbs., mixed with some rock, were obtained—the whole being estimated at 104,351 lbs.—averaging a little over 60 per cent. of clean copper. The ore put up in barrels is estimated by Captain Staples, who is now in charge of the mine, at 50 per cent. copper. The masses of solid copper are nearly pure, and ought to yield more than 90 per cent. of refined metal in the face—the only impurities being a little rock attached to the surface, or rarely included within the copper.

Descended into the shaft of the mine, which now reaches 208 feet in depth. Masses of copper were seen in the 2d and 3d shafts, and at the lowest level, where the metal is in solid veins, and quite pure.

These masses of pure copper are removed by finding some place where a hole may be made in the rock, and then firing a heavy blast, tamped by sand. This starts the copper from the wall rock, and sometimes removes it entirely from the rock. The masses are then cut up in the mines by means of chisels, as before stated. The mass now being cut up is 8 inches in thickness, on an average. The vein varies from two to four feet in width, and has no distinct *saalbandes* in the lower part of the mine, though they appear higher up. It seems to be a *true* and distinctly char-

erized vein, and increases in width and richness as it descends in the
k.

I measured the height of the cliff in which the vein is seen, and found
a level that it was 297 feet high, and to the upper exposure of the vein
height was 213 feet. The slope of the cliff is 40°, and the distance
asured on that slope to the top of the vein was 330 feet. By barometal observation, the height of the top of the cliff is 701 feet above the
el of Lake Superior.

A series of magnetic observations was made in the mines by my assist-
, Dr. Locke; and on the surface the declination was measured by Mr.
llet, my surveyor, on both sides of the vein, from the base of the cliff
ts summit. The following are the results obtained by the solar com-
s:

The course of the vein, as determined by solar compass, is N. 38° W.

Declination of the needle at the top of the vein, on the west side, 5°
E.; on the east side, 4° 50′ E.

Declination of the needle lower down, on the west side, 4° 35′ E.; on
east side, 5° 30′ E.

Declination of the needle at the upper drift, on the west side, 5° 45′ E.;
the east side, 6° 10′ E.

Declination of the needle at the junction of the compact trap and amygoid, on the west side, 2° 45′ E.; on the east side, 0° 50′ E.

Declination of the needle lower down, on the west side, not observed;
the east side, 6° 50′ E.

Declination of the needle all the way to the lowest drift, on the west
e, not observed; on the east side, 6° 50′ E.

For Dr. Locke's observations on the intensity of magnetism and the
linination of the needle in the mines, I refer to his report which is anred to this.

After making a pretty thorough examination of the mine, and fully exining it to all members of my party, I requested the superintendent to
cit the directors of the company to have a plan and section of the mine
pared, and to furnish me with a copy for the use of the government.
is I subsequently employed Mr. S. W. Hill to do for me, and it was
wn by Mr. W. Schlatter during the winter. I directed Mr. Hill to measevery opening, and to calculate the cubic contents of the space, so as
give some idea of the amount of work done at this mine. This was
ne according to my wishes, and is represented in the section furnished
me to the department, a reduced copy of which accompanies this re-
t. (See plate 1.)

*List of minerals found by me at the Boston and Pittsburg Company's
ne, on Eagle river.*—Native copper, crystallized; native copper, dentritic;
ive copper, impressed with crystals of prehnite; native copper, imssed with crystals of calc spar; native copper, impressed with crystals
quartz; red oxide of copper in fibrous crystals in the vein, also incrust-
the native copper; native silver in copper and in prehnite; analcime;
monite; compact table spar; anhydrous prehnite; cellular dentritic
rtz; calcareous spar; botryoidal prehnite.

July 2.—This day we went to Copper Falls mine, on township 58,
ge 31, section 11, to make an examination of their works, and to exn the mine to my party. On going from Sand bay, I took a barometl observation on the shore of the lake, and then proceeded through the

woods to the mines, and made barometrical observations there, and by these observations determined the height of the mines above the lake level.

At the shore, the barometer stood B. 29.530, T. 22° C., t. 21° C.

After allowing the barometer to cool, B. 29.515, T. 22° C., t. 19½° C.

At the office of Copper Falls mine, B. 29 30, T. 24½ C., t. 25° C.

The height by calculation is 211½ feet above the level of Lake Superior.

I descended into the mines, with my assistants, and explained everything to them, taking notes of every fact of importance Examined the 2d shaft, in which is the 80-feet level. The direction of the vein is, by compass, N. 26° to 30° W., S. 26° to 30° E. It dips to the westward 70°. There is a vein of solid copper, and a veinstone rich in a mixture of native copper and native silver. It is 18 inches thick, and the sheets of copper are from 4 to 6 inches in thickness. The vein becomes thinner to the northwestward. One of the masses of copper got out was 20 feet long, 9 feet wide, and from 4 to 6 inches thick, and weighed by estimation ten tons. There are five shafts sunk in this vein, the deepest penetrating perpendicularly 120 feet. The longest level is 80 feet in a straight line, and there is also a cross-cut of 20 feet at its extremity.

The adit level is 482 feet.

Shaft No. 1 - 78 "
" 2 - 120 "
" 3 - 43 "
" 4 - 11½ "
" 5 - 31 "

These five shafts were all carefully examined by me in company with the mining agent, Joshua Childs, esq., who politely aided me in my researches. He also promised to furnish me with a plan of the mine and with a good set of specimens of the ores and minerals. He has a handsome collection of the rare and beautiful productions of this remarkable mine. His crystals of metallic copper are the finest in the world, and many of his specimens of crystallized minerals are very perfect and beautiful. Among the curious ones is a singular variety of analcime, of a salmon red color, and presenting the singular form of a long rhombic prism, as if pseudomorphic. The terminations of these crystals are trihedral; the inclination of the planes on each other being about 100°. This mineral, by analysis, I afterwards discovered to be a mixture of leonhardite and analcime.—(See analysis.) It occurs in crystallized calcareous spar traversing the rhombic masses of that mineral, and is associated with regular crystals of analcime and leonhardite. I examined with minute accuracy every mineral in Mr. Childs's collection, and proposed to send Mr. Whitney to make drawings of the finest crystals, but he never had time to attend to it, having been occupied until after I left the field at the Ontonagon river. While at Copper Falls mines I directed a series of magnetic observations to be made by my surveyor, Mr. S. H. Mullet, for the purpose of learning the variation of the declination of the magnetic needle at different points around the copper vein; and Dr. Locke, my assistant geologist, also made his observations, which are contained in his report.—(See his report.)

Mr. Mullet reported to me the following results of his observations on the declination of the magnetic needle as determined by the solar compass. The observations were directed to be made on both sides of the vein, beginning below the lowest exposure of it.

On the east side of the vein, at the lower shaft, the variation was 6° ′ E., and in three different places towards the upper shaft the same re- lt was obtained. On the west side of the vein the variation was also und to be 6° 40′ E., in five different stations, so that it was evident ere was no magnetic disturbance produced by this vein.

Above the race or falls, where there is a junction of the sandstone and ap rock, the declination was 4° 25′ E., and three rods farther up on the ndstone it was 5° 20′ E. These observations accord with those made sewhere at the junctions of these two rocks, and prove that there is a cided effect produced on the magnetic needle by the contact of these o rocks, but that the copper vein has nothing to do with it. After ex mining these mines we walked to Eagle Harbor, which is two miles dis- nt, and spent the night there.

I saw Mr. French, the agent of the Eagle Harbor Company, who gave e much information concerning his operations in mining at Eagle Har- r. This company has been working with a small party of miners— ght of whom are now employed opening some of the neighboring veins. went with him and examined all these openings. Sixty rods back from e harbor 38 tons of copper ore was raised—5 tons of it being nearly pure pper, and the rest of it a mixture of copper, laumonite, and leonhardite. ne of these veins runs nearly north and south, or N. 1° E. It is 2 feet nches wide, and dips eastward 65°. This vein has been unfortunately ened like a trench, directly into the lake, and is now full of water. ne ore was tolerably rich, and can be very easily washed entirely free m the laumonite. The work has penetrated to the depth of 87 feet. few rods west of this is another pit where the vein is 2 feet wide, and nsists of copper, mixed with calc spar. The pit is now full of water. ne pit is 65 feet deep. Farther west there is another vein, 3 feet wide, d contains copper, mixed with a soft greenish mineral, resembling de- mposed serpentine. With this I found pulverulent black sulphuret of pper, associated with the pure metal. This pit is 35 feet deep. Farther st is still another vein, which is 2 feet wide, but it has not been wrought any extent.

West of this is the silver vein, which yields some good specimens of tive silver, near the surface, in the decomposed rock. Copper was und there in a sort of indurated clay, resembling decomposed serpen- ne, and in trap rock in small string veins, which were quite irregular.

Mr. French gave me specimens of all the ores he had raised, and offered furnish a plan of all his mines. He stated to me that he had measured id sounded Eagle Harbor during the winter, when it could best be done the ice, and that he found the harbor 4 rods less than a mile wide. he greatest depth of water in the harbor is 100 feet, and that on the bar 10 feet, and can be easily deepened there to 16 feet by blasting away e rocks. This ought to be done for the safety of loaded steamboats, hich frequently take shelter in this bay. The veins at Eagle Harbor ve proved richer than I supposed they would be when I first surveyed em in 1844, and are worthy of systematic mining—the operations which ve thus far been made being merely shallow explorations.

Mr. Taylor, of Eagle Harbor, also gave me some very curious speci- ens of native copper in analcime, and a very pretty piece of doubly re- cting calcareous spar, both of which he obtained at the mines at this ace.

List of minerals obtained at Eagle Harbor.—Datholite; laumonite; leonhardite; calc spar; agate; native copper; suphuret copper; and native silver.

July 3.—This afternoon after examining the mines, we took boat for Copper Harbor, and on our way examined Cyprus River Company's mine, on an island of trap rock, near Agate Harbor. We found string veins of laumonite, much pinched, containing a little copper, but they are of no value, and have been abandoned.

Running along the shore we verified my previous surveys, and stopped to examine the New York Company's mine, which was opened on a vein of sulphate of baryta, colored black by an admixture of sulphuret of copper. Various forms of sulphate of baryta are found here, and calcareous spar, colored jet black with black sulphuret of copper, occurs mixed with the baryta. The crystals of calcareous spar are the scalene dodecahedron, the six-sided prism, rhombohedra more obtuse and more acute than the primary, and an infinite variety of modifications of the primary rhombohedron. Some of the crystals, especially the variety called dog-tooth spar, are of a delicate blue color; others, especially the rhombohedra, are of a honey yellow, and the six sided prisms are sometimes transparent and colorless, or are jet black from admixture of fine particles of sulphuret of copper.

The sulphate of baryta is generally in the cock's-comb form of aggregation, and is very abundant. The crystals on the surface are white, while in the interior they are black, and a deeper colored mass of almost jet blackness is found on breaking up the specimens. The weight of this mineral deceived the miners and the geologist employed by the company, and led them into the erroneous belief that the ore was valuable, when it cannot be economically smelted; the mineralogist, however, feels indebted to the company for so large a supply of interesting specimens as they have raised in their mining operations—hundreds of tons of them lying about the mine. The vein is in conglomerate rock, and is of no value. Its direction is north and south. (For a list of the minerals obtained by me I refer to the accompanying descriptive catalogue.) In the evening we rowed to Copper Harbor, and remained there on the 4th and 5th of July.

July 5.—On this day a party of about 60 gentlemen, superintendents and others interested in the mines, with others resident on Keweenaw point, held a meeting and dined together, commemorating the Declaration of Independence of the United States. I was invited to attend this celebration, which was socially and temperately enjoyed, and it afforded an opportunity for each of the inhabitants to give an account of his labors, privations, and adventures in the first settlement of that district. This meeting enabled me to form some estimate of the enterprise and zeal of the early adventurers, and was highly instructive as well as entertaining. A few observations were made on the morning of this day. Dr. Locke was engaged with his magnetic labors, and the other members of our corps wrote up their journals of what they had seen. At 8 a. m., the barometer at Fort Wilkins, hung up 26 feet above the level of the lake, stood B. 29.54, T. 23° C., t. 23° C. The dew-point was ascertained to be as follows:

Temp. of air 23° C.—Deposition point 13½° C.
Vaporization point 14° C.
2) 27½
True dew-point 13¾

ese observations indicated fair weather, and I hastened to send out sistants on the several districts which I had assigned to them.

y 6.—This day Mr. Whitney, one of my assistants, was sent with y of sub-agents and voyageurs selected by him from our men, to go i river, where we expected he would be able to join the party of surveyors under W. A. Burt, esq., my instructions recommending should send one of my explorers with the linear surveyors, who o be instructed by the surveyor general to receive him into their

My written instructions for the survey of the district between eal and Ontonagon rivers were given to Mr. Whitney; (a copy is ded to this report.—See document B.) 5 p. m., B. 29.55, T. 84°, t Wilkins.

y 7.—Dr. John Locke was fitted out with a party of sub-agents and en, and left this day for Horse Shoe harbor, T. 59, R. 28 S. 36, to magnetic observations. The results he obtained will be found in port. Dr. Locke is to follow the coast from the head of Keweenaw Chocolate river, and then to survey two ranges of townships be- the Lakes Superior and Michigan.

y 8.—This day I proceeded with my party to examine the coast d Keweenaw point to Lac la Belle, and to note the exact places the junction of the sandstone and trap rocks took place. This ffected, and specimens of all the rocks and contained minerals were ed. At the extremity of Keweenaw point the barometer was ob- l at 2½ p. m.

remity of Keweenaw point, 8 feet above Lake Superior, at 2½ p. m., .50, T. 23° C., t. 23° C.;

remity of Keweenaw point, 8 feet above Lake Superior, at 3¼ p. m., .49, T. 23° C., t. 23° C.;

et above Lac la Belle, at 9¾ p. m., B. 29.45, T. 20° C.;

ice of Lac la Belle Mining Company, Sibley's, at 9¾ p. m., B. 29.18, ½° C.

remained over night at this place.

y 9.—8 a. m. barometer stood, at Mr. Sibley's office, B. 29.25, T. C.

et of altitudes of the sun, for the estimation of the longitude of the , were also taken in the morning.

er examining the mines, I took a series of double altitudes of the ust before, at, and after noon, for the determination of the latitude e place.

3 p. m., at Sibley's office, B. 29.24, T. 25° C., t. 25½° C. As- ng the mountain to the Bohemian Company's mines, we found, at n., B. 28.945, T. 27°, t. 26°. This observation was taken at the of the company. On the summit of the mountain, B. 28.625, ½° C., t. 26° C. One hour later, B. 28.630, T. 26° C., t. 24° C. t below the summit of the hill there is a vein of copper ore in a crystalline trap, and highly magnetic with polarity. The vein

runs north 22° west, south 22° east, and dips east-southeast from 63° to 70°. The vein is two feet wide, and consists of calcareous spar containing gray sulphuret of copper. Upper mine, B. 28.70, T. 26° C., t. 25° C. Here we observed two veins of copper ore running northeast and southwest, and dipping to the northwest 65°, consisting of nearly pure gray copper ore. Descending the hill, at the first shaft of the Bohemian Company's mines we found the B. 28.865, T. 26° C. I obtained a collection of specimens of the rocks and copper ores, and returned to the Lac la Belle Company's cabins.

July 10.—Examined the Lac la Belle Company's mines in the morning, and at noon took a series of double altitudes of the sun for the determination of the latitude of the place:

At noon, B. 29.20, T. 26½° C.

2 p. m., B. 29.20, T. 26¼° C.

Lac la Belle mine.—The lower drift, excavated by the miners employed by this company, was made for the purpose of exploring a vein of gray copper ore, which was discovered by the miner, W. Richards, while in Mr. Sibley's employ.

The drift measures 200 feet in length, is 6 feet high, and 4 feet wide. This opening exposes the vein, which is found to dip to the eastward about 60°. The vein is quite irregular—its width varying from 2 feet 2 inches to 4 feet. The ore is scattered throughout a veinstone of calcareous spar, and in some places it is quite rich in copper ore. Its general average yield of copper is about six per cent. There is a cross course or branch vein exposed near the mouth of the drift, which is from 2 to 3 inches thick. Its course is nearly east and west.

The magnetic needle is much disturbed by this crossing, and points north and south along a drift which runs east and west. The cross vein dips north 60°. In the upper drift the principal vein was found to dip to the east 60°, and to run nearly north 20° east, while the cross vein runs east and west, and dips north 70°. An opening or natural cave was found, where the upper drift enters the hill. It was 30 or 40 feet in length, and afforded the first view of the vein to the original explorer. The drift excavated here is 70 feet long.

On testing the temperature of the springs of water which open into this drift, I found it to be +7° C., while the air in the drift stood at 10° C., and the exterior air was at 26° C.

Owing to natural crevices, the upper level is quite wet from the infiltration of surface water, while that below is comparatively dry. A branch of the east and west vein runs northeast by east, and is mostly solid copper ore, and 2 feet in thickness. Gray sulphuret of copper, purple copper, yellow copper, and iron pyrites, are the ores found in this vein. Although the average yield of the vein is low, there are rich pockets here and there which yield a considerable quantity of ore, containing upwards of 40 per cent. of copper. It is proposed, if mining operations are continued here, to erect a stamping mill, so as to be able to pulverize and wash the ore up to 25 per cent. before reducing it to black metal—the state in which they propose to send the ore to market.

I took the temperature of the air and water at the farther end of the 200 feet level, and found it to be the same as in the upper drift before mentioned, the temperature of the exterior air being 25° C.; that in the mine

s 10° C., and the temperature of the water was 7° C. These obser-
ions were made almost 100 feet below the surface of the ground.

6 p. m., Sibley's, B. 29.17; T. 25½° C; t. 25° C.

Dew-point 17½°; temp. of air, 25° C.

July 10.—Saturday evening, finished my surveys of Lac la Belle and
hemian Company's mines, and was about leaving, when to our sur-
se Dr. Locke and his sub-agents arrived at Lac la Belle, and informed
e that their boatmen had all deserted them, and had set out on foot to
urn to Copper Harbor. I learned that the mutiny was got up by the
atmen, because Dr. Locke would not allow them to make as free use of
sugar as they wished, and that their demands were unreasonable.
t knowing what mischief they might do at Copper Harbor, I immedi-
ly sent a person through the woods with a letter to Sergeant Wright,
uesting him not to harbor the deserters at Fort Wilkins.

While Dr. Locke remained with me he measured the height of Bohe-
an mountain, and obtained results within a few inches of those already
ained by me. Dr. Channing also repeated the measurement, with the
ne results. Taking advantage of this visit to the Bohemian and Lac
Belle mines, Dr. Locke and Mr. Mullet made a series of very interest-
magnetic observations on and around the veins of copper ore. The
ults of Mr. Mullet's surveys are exhibited in the accompanying dia-
m. Dr. Locke's observations are contained in his report on the mag-
ism of our district.

In order to have other comparisons of our barometrical measurements,
equested Drs. Locke and Channing to measure the height of Mount
ughton, and I subsequently went there and measured it myself. The
ults of these separate measurements agreeing within a foot, gave assur-
e of the fidelity of those delicate instruments.

About 100 tons of copper ore have been raised by Mr. Mandlebaum's
ners at the Bohemian Company's mine, and the ore is estimated to
ntain about 6 per cent. of copper. The cost of driving his drift was
m 5 to 6 dollars per linear foot—the dimensions of the opening being 6
t in height by 3½ feet in width, or 21 square feet. In sinking the shaft
e cost was from 7½ to 8 dollars per foot. On the drift they excavated
m 3 to 5 feet in a week, while in sinking the shaft they penetrated from
o 4 feet per week. He employed 10 miners, who worked only in the
y time during the summer. In winter, when the air of the mine is
re, they will work night and day.

Mr. Sibley, agent of the Lac la Belle mines, employs 10 miners, a min-
captain, 4 laborers, and a blacksmith.

From one of the small but rich veins of gray copper ore, they have ex-
cted, and have now on hand, 75 bbls. or 20 tons of rich copper ore,
nich will yield from 25 to 30 per cent. A few tons of the picked ore
d already been sent to the smelting works near Boston, and by my
say it was found to contain 40 per cent. of copper. The ore is rich
ough, but this vein is narrow, while the wide vein is comparatively
or. Farther explorations will be made to find the vein at the base of
hemian mountain, so as to prove it at a lower point. This mountain
admirably adapted for easy mining, and it is hoped it may yield a profit-
le supply of copper. It is, however, as yet uncertain.

July 11.—Took a series of altitudes of the sun this morning for time.
rometer at Sibley's office at 11¼ a. m., B. 29.192; T. 26° C.; t. 26°

C. The dew-point at the same time was found to be 14½° C. At noon B. 29.17; T. 27° C.; t. 27° C.; 1 p. m., level of Lac la Belle, B. 29.45; T. 29½ C.; t. 29° C.

Set out for Mount Houghton, and examined the location of the Alliance Company at the base of the mountain, Mr. D. Sharwood, the agent of the company, politely accompanying us, and lending us every possible assistance.

Before ascending Mount Houghton, I endeavored to measure its height by laying out a base line on the beach, and measuring angles from the zenith by means of the sextant, after the ingenious method proposed by Monsieur le Prof. Elie de Beaumont; but owing to the shortness of my base line, and the high refraction of the atmosphere, accurate results could not be obtained by trigonometrical means. The barometer was therefore considered our most reliable instrument.

The first levelling by the barometer fixed the height of Mr. Sharwood's cabin, where we spent the night, and the next morning the work was renewed, and the height of the summit of the mountain was measured from that place; and on returning, this was verified by repetition of the observations.

Level of the lake, 5 p. m., B. 29.365; T. 24½° C.; t. 23½° C.
B. 29.365; T. 24½° C.; t. 23½° C.

Ascended immediately to Mr. Sharwood's cabin; where, B. 29.155; T. 25° C.; t. 24° C.

July 12, 11½ a. m., B. 29.150; T. 28° C.; t. 29° C.

Dew point—deposition point 18° C.
Vaporization point 19° C.

2)37°

True dew-point 18½° C.

3½ p. m., at Sharwood's cabin, B. 29.19, T. 27° C., t. 27° C. Set out for the top of Mount Houghton, where,

At 5 p. m., top of Mount Houghton, B. 28.58, T. 26½° C., t. 24° C.

After standing to equalize the temperature—

Top of Mount Houghton, B. 28.57, T. 26° C., t. 24° C.
Do. B. 28.57, T. 25½° C., t. 25° C.

Declination of the magnetic needle on top of the mountain was 5° 10′ east. The rock at this place is a dull red jasper, stratified in structure, and splitting into thin sheets. It is supposed to be an indurated fine red sandstone, which has undergone partial igneous fusion by the heat of the trap rocks, which are in immediate contact with it.

After examining the geology of the mountain and collecting specimens of the rocks, we returned to Sharwood's cabin. The jaspery rock on Mount Houghton runs south 80° west, and dips northward 70°. This observation was made on the east side of the mountain. On our way up and down the mountain we noticed the soil and the forest trees, and observed one pine tree, which had been struck by lightning, to be 16 feet in circumference at four feet above the roots. The forest trees indicate a good soil.

After exploring the land towards Lake Superior we returned to Sharwood's cabins, and found B. 29.25, T. 22½° C., t. 21° C.
B. 29.25, T. 21° C., t. 19° C.

	Feet.
From these observations we calculated the height of Sharwood's cabin, above the lake, to be - - - - -	245.2
Height of Mount Houghton above Sharwood's - - -	620.8
Height of the summit of the mountain above the level of the lake	866

The measurements of Drs. Locke and Channing differed from mine only 14 inches: so we may regard this height of the mountain as correctly ascertained.

In company with Mr. Sharwood, we examined the rocks for copper; but very little was found. The works commenced here had already been abandoned, there being no regular vein, and only a few scattered particles of copper in the rock. The excavation made by the miners is on the east side of the mountain, on a cliff which opens upon the lake. Explorations have been undertaken on the north side of the mountain, but with no successful results.

The jaspery rock reaches, according to Mr. Sharwood, nearly to Bohemian mountain, and extends to the lake shore. We had observed it near the Little Montreal river, forming bold headlands extending into the lake. After packing up our specimens, we returned to our boat on Lac la Belle, and set out for Copper Harbor, stopping along the shore wherever anything attracted our attention, collecting specimens of the rocks and minerals on our way. Some fine agates were seen in the amygdaloid; but it is almost impossible to get them out whole without blasting the rock. The limits of the rocks are pourtrayed on the geological map which accompanies this report, so that it is unnecessary to describe their positions with respect to the township lines.

July 14.—Copper Harbor, Fort Wilkins, B. 29.44, T. 21° C., t 21° C.; dew-point 9½° C., temperature of air 21° C. Went to Porter's island to see Professor Mather and Mr. J. W. Foster, and left one of my barometers with Professor Mather to observe regularly.

July 15.—Heavy thunder-storm coming up; barometer falling rapidly. It rose again as the storm came on. The lake waters retired from the shores, and the level was reduced a foot, and then flowed in again, in as remarkable a manner.

Professor Mather and Dr. Locke observed this oscillation of the lake corresponded with barometric fluctuations. I was desirous of ascertaining if this was a general cause of sudden movements of the water, which could not be traceable to the influence of winds, and requested Mr. Mather to keep for me a regular meteorological journal, and observe the movements of the waters at Porter's island, which is a spot favorably situated for such observations; he has furnished me with the original record of his observations—a table, appended to this report, with my barometrical observations.

July 16.—This morning we have another severe thunder squall, accompanied by violent wind. The wind renders the observations on the rise and fall of the waters of the lake uncertain. B. 29.14, T. 23° C.

Saw Mr. Keeny, who is here for the purpose of obtaining copper for the Baltimore smelting works.

July 17.—The storm being over, this day Dr. Locke resumed his voyage along the coast on his way to Chocolate river, taking with him a new party of boatmen. We purchased of Messrs. Mather & Foster their boat,

which we found already named the "Geologist," a name we allowed to be continued. Mr. Foster was desirous of being employed by me, and Mr. Peabody, my sub-agent, thinking he would prove useful, and would contribute some drawings of scenery he had made on the lake, which would add to the interest of the report, earnestly requested me to allow him to resign his place of sub-agent and to appoint Mr. Foster. The offices were all filled, and this was the only way in which a vacancy could be created. I acceded to Mr. Peabody's proposal and appointed Mr. Foster to the place he had left vacant. Mr. Peabody took upon himself the *nominal* duty of packman of instruments, but really performed high *scientific labors*, making most of the barometrical and astronomical calculations required. His object in resigning his place was to avoid being sent away on a separate section, wishing to be constantly with me in order to improve himself in mineralogy and geology. The difference in pay was regarded by him as of no account, and, for a supposed advantage to the survey, he generously gave up his place of his own accord. The next movement I contemplated was to go to Isle Royale and make a complete exploration of the geology and mining resources of that island. An opportunity was afforded for making a rapid tour of the northwestern portion of the lake in a steamboat, which was to take a party around the shores, and land at every point of interest. This gave me a chance to make a general reconnaissance of the coast and to fix the positions of several places by astronomical observations; while it would not retard our contemplated explorations of Isle Royale more than a few days. This was the only way in which we could get to Isle Royale, no other vessel going there, and the traverse being too far for our boat to cross over.

July 18.—We embarked in the steamer Julia Palmer, and ran to the Ontonagon river, where we found that Mr. Whitney and party had just arrived, and had gone up the river about 15 miles seeking for the chief of the linear surveyors. I examined some boxes of minerals which had been brought down from the copper mines, and obtained some specimens of red oxide and native copper from Mr. Hubbard, who is opening a mine about 10 miles up the river.

The Ontonagon river is the largest stream which enters Lake Superior. Its waters are deep enough at the mouth of the river for boats to enter, and is navigable for them up to the falls. A long and narrow island divides the river into two channels, through which the water slowly and tranquilly runs, and empties into the lake over a bar which obstructs the current.

The soil is coarse and sandy, but it is said to be productive. There were good kitchen gardens near the few houses which have been erected at this place.

Several companies have locations on this river, and if they should prove to contain workable copper mines a considerable settlement will be made at the mouth of the river. The land is reserved for the use of the government at this place. Left a letter for Mr. Whitney at the Ontonagon post office, and then left for our voyage to Montreal river, stopping at the base of the Porcupine Mountains to obtain a meridional altitude of the sun, and to examine the rocks on the coast. By this observation it was found the R. 43, T. 51 N. section 10, is in latitude 46° 49′ north. The rocks at the base of Porcupine Mountains are fine-grained compact red sandstone, the strata of which dip to the nortwest 15½°.

July 19.—We reached Montreal river, where I took some observations

examined the rocks on the coast, and at the falls. The Montreal presents many attractions for the admirers of picturesque scenery, and bits the most beautiful waterfall existing on the coast of Lake Su-or. Not far from the mouth of the river we came to red sandstone s, which dip to the northward 70°, and it is a steep ledge of this rock :h produces the falls of the Montreal river, the water precipitating itself the edge of a cliff 80 feet in height and falling into a deep circular a, while the rushing waters have excavated a sort of amphitheatre nd this pool. The actual fall of water is but 60 feet, the river having ı channel of 20 feet in depth into the ledge. We walked on a little bank ıelf of sandstone around one side of the pool, and directly under the hanging ledges on one side of it, and from a measured base the an-were taken, whereby I ascertained the height of the falls as above d.

ly 20.—Continued our voyage to La Pointe, where I made a set of ob-ıtions for time, and a meridional altitude of the sun for latitude. : which I met with Dr. Norwood, the assistant geologist on Dr. D. D. n's survey of Wisconsin, and with him I made comparisons of our nometers and barometers, and found that they agreed perfectly with other. We arranged as to hours of observation so that our labors ıt prove serviceable to both parties. Remained at La Pointe two ; and by the meridional altitudes of the sun, I obtained for the lati-of that place, 1st, 46° 46′ 24″.6; 2d, 46° 46′ 25″.3: results :ing so nearly that they may be regarded as approximations to the true ıde, although I am aware that many observations are required for the exact results. My watch, set to Boston time, was found to be 1h. 9′ fast for mean time at La Pointe. By observations on Isle Royale, ate of the watch was 11″.48 per diem loss. The true difference in between Copper Harbor and La Pointe is 13″, or 195 minutes in longi-. This, of course, is but an approximation, and is given as such, for itude requires a great many sets of observations and several carefully l chronometers. Next season we hope to be provided with two chro-eters.

ly 22.—Measured the temperature of the water of Lake Superior, off on river. Temperature of air = 8° C.; temperature of lake = 3½° C. are now about 25 miles from Isle Royale; four miles from the shore ›igeon river. Temperature of air = 9° C.; temperature of lake = 5° C. ent on shore to see the mines of the British North American Mining ıpany, and visited Mr. T. Childs, the agent of the mines, who gave ome specimens, and showed us the mines, which appear to be quite in silver at the surface, but thus far no deep working has been at-pted to prove the quality of the vein as it extends downwards. The ı is composed of calcareous spar and sulphuret of zinc, filled with thin es of pure metallic silver. This vein is made up of a series of highly-in-ed bands of calcareous spar and trap rock, the aggregate width of the ›le being six feet. The dip of the vein is WSW. 70°. On entering shallow drift excavated by the few miners who have been employed ›, I obtained some very rich specimens of native silver from the vein. assay of a sample of the pulverized ore, two and a half per cent. of ›r was obtained. There is very little copper ore and no native copper ıis mine, and the whole character of the lode is entirely different ı the mines on the south shore. I shall feel much interested in learn-

ing the results of deep workings at this mine. Near the silver vein is a vein of galena associated with beautiful crystals of amethystine quartz. This vein is two and a half feet wide, and runs N. 30° W., S. 30° E., and dips to the westward 85°. Having but one hour to spend at this place, I could not make so full an examination of the veins as I desired. I regard the mine as interesting to all who are engaged in similar works on Lake Superior.

July 23.—We reached Rock Harbor, on Isle Royale, and were left there with our boat by the steamer. We pitched our tent in a little grove near the shore, and laid out our plan of operations, visiting first the mining ground belonging to the Ohio and Isle Royale Mining Company. I took advantage, also, of every opportunity to obtain observations for the purpose of ascertaining the geographical position of the island. The latitude observations are all sufficiently accurate; but, for want of chronometers, I could only obtain approximations to the true longitude, though for short trips I found I could rely on my watch, which had been carefully adjusted and regulated in Boston, and has a well-arranged compensation balance. The results of the observations taken will be inserted in the appendix. It was no part of my duties to make astronomical observations, and I was not provided by the government with any instruments for that purpose; but I have been able, by means of my own instruments and by taking advantage of time and place, to contribute something, however imperfect it may be, to the geography of the country. Had I been permitted, it would have given me pleasure to have done more, and, by use of good chronometers and other instruments, to have completed a series of more valuable observations than I have here volunteered to give.

July 24.—This day we examined the openings which have been made by the Ohio and Isle Royale Company near Rock Harbor. At one place, near the houses put up by Mr. Ransom, there are crystals of quartz, colored brownish red by suboxide of copper, as determined by Mr. J. H. Blake, who accompanied us. Some native copper was found at that place, but there is no vein of any value there.

We then made an excursion to a place which Mr. Blake had named Epidote, from the large beds of that mineral which are found there. It is five miles SW. from Rock Harbor, and in latitude 48° 2′ 8″ north, according to my observations. The whole coast is composed of trap rocks, with two beds of epidote rock, the upper of which is full of native copper. The copper-bearing bed is about one foot in thickness, and consists of a yellowish green granular epidote, filled with angular grains of pure metallic copper very uniformly distributed, and constituting from 8 to 20 per cent. of its weight. Under the copper-bearing bed there is another bed of epidote, more compact in structure, and about five or six feet in thickness. This bed contains stellated masses of a mineral which I named chlorastrolite. This mineral is found also among the rolled pebbles on the shore and on the beaches of an island at Rock Harbor, and was first observed there by J. H. Blake, esq.

It will be difficult to blast away this lower bed of epidote rock in the process of mining, for it is very hard to drill, and does not come out readily in good-sized masses. The dip of the copper-bearing bed is to the SE. by S. 28°, and the course of the outcropping edges is nearly NE. and SW. In mining here, the work will have to be carried on by a sloping shaft, or inclined drift, following the dip of the bed. No timber

will be required, for the trap rocks forming the roof are sufficiently
d and compact to sustain the pressure. Small true veins of datholite,
careous spar, and prehnite, containing spiculæ crystals and sheets of
per, are seen traversing the trap rocks and cutting through the epidote
ls in their course. They dip to the NW. by W. 60°. They are from
to three inches wide, and are quite rich in copper. One of these
ns was opened by the Ohio and Isle Royale Mining Company, under
direction of Mr. Blake, and was found to widen from one to three
hes as it descended eight feet. There are numerous veins of this kind
this coast. The small veins in this part of the island generally run
. and SW., and dip to the NW. Preparations are now making by the
erintendent of the Ohio and Isle Royale Mining Company to test both
epidote bed and the cross veins. From the situation of the epidote
s, it appears that, since they dip towards the lake shore at this place,
y must break to the surface inland at a short distance, if their dip is
ılar. If worked from the shore, the drift will ascend, and no trouble
n water or foul air will be met with. The company now employs
ut fifty men, and has made great improvements at Rock Harbor—erect-
good buildings, cleared a large area of land, made a good garden,
ough which a brook flows, and is crossed in the middle by a good
lge. The soil is fertile, producing most of the ordinary culinary vege-
es in abundance. It is probable, if mining operations should prove
antageous on Isle Royale, that a village will spring up in this place;
, since the improvements alluded to were first made by Mr. Leander
ısom, of Cleveland, the place is properly named, in his honor, "Ran-
ı."

Lock Harbor is the largest and most beautiful haven on Lake Superior,
eep enough for any vessels, and is perfectly secure from every wind.
e numerous islands which stand like so many castles at its entrance
tect it from the heavy surges of the lake. In some respects it resem-
the bay of Naples, with Procida, Capri, and Ischia at its entrance;
no modern volcano completes the background of the picture, notwith-
ıding the traditions of there having been earthquakes and eruptions in
orical times on Isle Royale. Igneous rocks, most assuredly, do con-
ute the rocky basis of more than four-fifths of the island, and there
st at one time have been greater eruptions there than ever took place
taly; but still this was at a period anterior to the existence of human
ıgs on the globe.

sle Royale is a most interesting island, singularly formed, cut up into
p bays, and sending out long spits of rocks into the lake at its north-
ern extremity; while at its southwestern end it shelves off far into the
e, presenting slightly inclined beds of red sandstone, the tabular sheets
which, for miles from the coast, are barely covered with water, and
r dangerous shoals and reefs, on which vessels and even boats would
quickly stranded if they endeavored to pass near that shore. How
erent is the coast on that portion of the island where the rocks are of
eous origin! Bold cliffs of columnar trap and castellated rocks, with
ral escarpments, sternly present themselves to the surf, and defy the
ms. The waters of the lake are deep close to their very shores, and
largest ship might in many places lie close to the rocks as at an artifi-
pier. The color of the water, affected by the hues of the sky, and
ling no sediment to dim its transparency, presents deeper tints than
seen on the lower lakes—deep tints of blue, green, and red prevailing,

according to the color of the sky and clouds. I have seen at sunset the surface of the lake off Isle Royale of a deep claret color—a tint much richer than ever is reflected from the waters of other lakes, or in any other country I have visited. Added to the fantastic irregularities of the coast and its castle-like islands—the abrupt elevation of the hills inland rising like almost perpendicular walls from the shores of the numerous beautiful lakes which are scattered through the interior of the island, and corresponding with the lines of the mountain upheaval—we observe occasionally rude crags detached from the main body of the mountains, and in one place two lofty twin towers, standing on a hill-side, and rising perpendicularly, like huge chimneys, to the elevation of seventy feet, while they are surrounded by deep green foliage of the primeval forest. I requested my assistant (Mr. Foster) to make a sketch of these singular towers, while I was engaged in measuring their height. (See plate.)

Not less strange and fastastic are the effects of *mirage* on the appearance of the peculiar scenery of this island, and the northern coast of the lake seen from it. For weeks in summer the traveller may be gratified by a view of the most curious phantasmagoria—images of the islands and mountains being most vividly represented, in all their outlines, with their tufts of evergreen trees all inverted in the air and hanging over their terrestrial originals, and again repeated upright in another picture directly over the inverted reflection. A very beautiful view of mirage of this character was represented near Rock Harbor, where the islands presented an appearance as shown in the accompanying drawing.

In the deep valleys which traverse the interior of the island, between the hills, there are either small lakes or swamps filled with a thick growth of cedar trees. On the hills there is a mixture of maple, birch, spruce, fir, and pine trees, which are of thrifty growth, and will afford both timber and fuel. The soil formed by the decomposition of trap rocks is well known to be warm and fertile; and so far as cultivation has extended here, this soil will sustain a character equal to that of the trap ranges of Nova Scotia. In the low lands, the cold springs from the hills keep the soil cold and wet; but where they are not thus exposed, or if the lateral supplies of water were cut off by artificial drainage, I have no doubt the soil might be cultivated and would produce good crops. This has been proved by Mr. Ransom, at Rock Harbor, where the low-land soil, which was originally covered with swamp muck, is now drained and fertile.

Under the shade of the crags, and among the thick evergreen swamps of white cedar, it not unfrequently happens that perennial ice is found, covered by a layer of turf. Mr. Blake discovered a considerable area of ice thus preserved in midsummer, near Rock Harbor. On the immediate rocky border of the island, the influence of the cold air from the lake is most strikingly exemplified in the stunted growth of the fir and spruce trees which cover the rocks; and in numerous instances we were able also to witness the joint effects of cold air and a limited supply of soil, in reducing the growth of trees, and giving the wood an extremely fine texture. In the cracks and crevices of trap rocks, where a little soil remains, we find small trees have sprung up, having all the appearance of age which the dwarfed trees raised by the ingenious Chinese gardener are known to present. These little trees, from four inches to a foot high, are covered with mosses like old trees, and the tiny stem presents in its bark and wood the different layers representing many seasons. In cutting through these little trees, they were found, in some instances, to possess forty dif-

ferent annual rings, indicating as many summers. Mr. Blake made a collection of numerous specimens, bearing proofs in their structure of great age. The wood of spruce or fir in these diminutive trees was found nearly as hard as boxwood, and as fine. The trap rocks on this coast are very compact, and more crystalline and less vesicular than those of Keweenaw point. They are also distinguished by the greater prevalence of epidote beds and datholite veins. Indurated clay and semi-jasper veins also occur in it. Some of the trap is porphyritic, and it occasionally becomes so crystalline as to resemble sienite. Among the loose rounded stones or boulders are noticed porphyry, with a red felspar base, containing occasionally a little quartz, and spotted with large crystals of a lighter red felspar and granite, with white and black mica. There being no porphyry or granite in place on the island, these boulders must have been transported from a distance and deposited here. They cover not only the coast and low-lands, but also the highest hills and elevated valleys.

On the shore occur pebbles of all the different rocks and minerals of the coast, mixed with drift boulders, which have been transported thither in former times. Lumps of native copper and polished pebbles containing it are frequently met with on the shore, and were known to abound there in former times—the aboriginal tribes having been found to be fully acquainted with the fact that loose pieces of copper were readily procured on the shores of Isle Royale.

Sunday, July 25.—Remained in camp. Day rainy and cold. Wrote up journal.

Monday, July 26.—Last night, it was very cold and uncomfortable. This day, went up the bay of Rock Harbor about one mile, to examine a vein of cupriferous epidote in the rocks where the trap and sandstone join. This vein dips to the N. by E. 50°, while the strata of sandstone dip to the SSE. 12°. The copper-bearing epidote is from 4 to 6 inches thick, and contains sheets of copper between its layers, and spiculæ of copper in its mass. Pieces of the vein or bed break out into rhombic prisms, exhibiting the usual smooth joints of slaty cleavage, often glazed with layers of bright green epidote. It was obvious that this bed could not be wrought profitably, the ore being too poor in copper to pay for its extraction.

Rowed up to the head of the bay, and took a set of observations for latitude near and at noon, by which it was ascertained that this point is in latitude 48° 4′ 25″ N.

July 27.—We set out on our tour of circumnavigation of the island, stopping to examine minutely every point of interest. Leaving Rock Harbor, we coasted along the shore towards the eastern extremity of the island, and stopped first at the Union Company's location, two miles from Rock Harbor. This location is in charge of Mr. Charles Whittlesey, and is now undergoing exploration by him. There is a vein containing native copper at this place. It is five feet wide, runs nearly east and west, and dips to the north 82°. Some very fine specimens of copper have been obtained here. Three miners are employed in sinking a pit for exploration of the vein. We took the course of the vein accurately by means of the solar compass, and found it to be N. 88½° W. The declination of the magnetic needle was 6½° E. at the mine. I examined three small veins of copper and calcareous spar which traverse these trap rocks. The copper is mostly in sheets, and lies in contact with the walls of the vein, which is well de-

fined. Mr. James Hubbard, the agent of this company, showed us every desirable attention while we were at this place. The mines are 200 yards from his log-house.

Visited Mott's island, where we saw a small copper vein, 4 inches wide. Its course was S. 80° W., N. 80° E., and dips N. 50°. The veinstone is 2 feet 4 inches wide, but is not all metalliferous. One end of this island is trap rock, and the other conglomerate. Trap breccia was observed near the line of junction, as usual. Keweenaw point was seen in *mirage* from this place.

On completion of our examination of this location, we rowed to that of Mr. Scovill, where we camped for the night—8 p. m., B. 29.38, T. 13° C. This point is composed of columnar trap rock, having a basaltiform arrangement, the colors being quite distinct, and in three and five-sided prisms, which, on the extremities, being polished by the action of the waves, presented the appearance of a pavement. In the cliff, there are inclined columns resembling very much the basaltic rocks of central France.

July 28.—This day we examined Mr. Scovill's mine. The vein is a greenish mixture of calcareous spar, prehnite, and trap, containing sheets and spiculæ of native copper. The course of the vein is N. 65° E., S. 65° W., and dips NW. 68°. It is from 1 foot 3 inches to 2½ feet wide, and has some lateral string veins, or *leaders*, as the miners call them. A shallow pit has been sunk on the vein, but thus far the ore does not appear to be rich enough to encourage mining, though some good specimens have been obtained.

We followed this vein along its course, southwestward, to a place where Mr. Shaw has attempted some explorations, by sinking a pit on the vein. This location is taken out in the name of Captain Smithwick. It is 100 rods southwest from Mr. Scovill's pit. A marked ravine and fossa in the ground indicate the line of the vein to be continuous to this place. The exact direction of this line, surveyed by Mr. Mullet, was found to be, by solar compass, S. 61½° W. The declination of the magnetic needle was 6½° E. Although some rich mixtures of copper and veinstone were obtained, this mine does not yet appear to be rich enough to warrant the expenses of mining. A few specks of silver have been found in one part of the vein, but we did not succeed in obtaining any.

Near the lake level, 11 a. m., B. 29.185, T. 12½° C.
8 p. m., B. 29.095, T. 10° C.

July 29.—This day we set out for Duncan's location, and examined on our way the Castle Rocks, or Cloven Towers.

Crossing the bay, we passed some pretty islands of trap rocks, covered with tufts of spruce and fir trees, and landed on the shore on the other side; then, entering the woods, we walked about a mile, clambering over high ledges of trap rocks, which rise at an angle of from 40° to 45°, and, traversing a thick forest and a small cedar swamp, we came to the elevated land on which are situated the Castle Rocks. These curious needles or chimneys of trap rock reminded me of the celebrated rock at Puy, in the department of Puy de Dome, in central France. They are not of so large dimensions, but are much more slender and obelisk-like. Their position is quite remarkable, for they stand like monuments on the side of a hill three or four hundred feet above the level of the lake, and do not exhibit any marks of abrasion from causes such as have rounded the neighboring

lls. How they came to escape the denudating force of ice and water of ıcient times, is not apparent; but they are evidently outliers of the ighboring trappean hill, on the side of which they stand now so conıicuous. They are evidently in place, and not detached blocks. A fine ew of them was obtained by felling the trees which stood in our way; ıd while Mr. Foster made his sketches, I measured their height, with ir Howard Douglass's reflecting semicircle. One of them was 70 feet igh from its base, and the other 60 feet. In one point of view they apear like leaning towers, and in another they seem to be quite vertical. heir structure, being jointed, gives them the appearance of an artificial ork, and might lead some to suppose they were the work of some former ce of men—natural geological monuments having been thus frequently istaken for works of art. After making all the examinations of this place hich were desirable, and observing the bearings of certain well known ints, in order to designate this position, we went to Mr. Duncan's cabin, out three quarters of a mile distant, and dined with him, on the roughıt backwoods fare, and then returned through the woods to our boat, and wed back to our camp at Scovill's point, amid a shower of rain. Rain ntinued all night, with wind from the southeast.

July 30.—Storm still continues, and the weather is cold. Temperature C. Remained in camp engaged all day in writing.

July 31.—Storm continues; 9 a. m. B. 29.11, T. 13° C.; 1½ p. m., B. .17, T. 16° C.

August 1.—9 a. m., B. 29.395, T. 17° C. Weather cleared. Set t on our voyage again. Having learned that Mr. Ives and his party surveyors were confined on Passage island by the storm, and were probly without provisions, I sent the boat to relieve them; but they had ıt succeeded in embarking when our boat reached the island. They me to see us soon after, and arrangements were made to join one of my rty to theirs for exploration of the interior of the island, while I explored e coast with other members of the corps. Mr. G. J. Dickenson was deıhed for this service, and continued with Mr. Ives until the season's ork was over. Mr. Mullet was subsequently sent to assist Mr. Dickenn in this service.

At noon we reached the spit called the Little Finger of Isle Royale, and ere took a series of observations of the sun at and near noon—the meılional altitude giving for the latitude of that point 48° 10′ 25″ north. The cks at this point are hard greenstone trap. We ran over to Amygdaloid and, and entered a narrow bay with sandy beach and bottom, walled in cliffs of trap rocks on both sides. The water of this little boat harbor shallow and is quite warm, so that myriads of delicate shellfish, the mnea, cover the bottom and shores. I noticed marks made in the fine nd by the movements of these little molluses, which resembled marks I ıd seen on fine sandstone, and which are called, perhaps erroneously, coides. We pitched our tent on the sandy shore, and spent the night at is place.

August 2.—8 a. m., B. 29.54, T. 14° C., at lake level. Time obrvation taken here just before we left. (See tables of astronomical servations.) Crossed over the island to a location claimed by Matthewı Miller, whom we met just after leaving this morning. This location ılso claimed by the American Exploring Company. Our examination s, however, likely to end the dispute, for we found the little vein they

were contending for to be utterly worthless. At the so-called mine we found Mr. Curtis Fowler and some men rebuilding a log-house in the place of one which had been burnt down by an accidental fire in the woods. The house is built for the purpose of claiming pre-emption when the land shall be sold by government. The original building, I was informed, was erected in June, 1846, and it was burnt down last month. The vein they were exploring is composed of hard epidote, and is only four inches wide, and very poor in copper. It dips to the north by east 48°, and occupies a ravine about three feet wide, worn by the surf. The trap rocks are very hard and not amygdaloidal, and mining here would be an absurd waste of labor and money. There seemed, however, to be no want of faith in its value among those whom we met there, for they were about to procure supplies and commence mining. I advised them to abandon their project.

Leaving this island, we crossed over to Miller's location, on the main land, and camped. This location has already been surveyed by Mr. Ives and his party.

Level of lake, 7½ p. m., B. 29.55; T. 19° C.; declination of the magnetic needle 6° east.

During the day we have had a view of a most remarkable *mirage* on the north shore of the lake, where Thunder cape, a bold headland 1,300 feet high, is seen changing its shape in a very remarkable manner, occasionally appearing inverted, in part, in the air, and frequently sending out a long figure like the horn of an anvil on the right of its table top. This projection on the sky we found to be the reflection of the shore at the base of the cliff, and it was perfectly obvious that the mirage must be produced by the condensation of a film of moisture from the warm air which moves from the heated woodlands of the interior over the colder air of the lake. Refraction alone could not produce so wide a separation between the object and its image. The islands on the north shore, called the "Paps," were seen inverted by mirage; and these phenomena were many times repeated in the course of a few hours.

August 3.—Level of lake 6 a. m., B. 29.57, T. 15° C. This morning we examined Miller's copper vein; it was found to run nearly east and west, and to dip to the north. It is two feet wide. Near this is a smaller vein, which has a course north 60° east, south 60° west, and dips to the north. About thirty pounds of copper have been got out of these veins by means of the pick and gads, but no mining explorations have been made, and the vein does not seem to warrant much outlay in its examination.

We left Miller's, and went to the Pittsburg and Isle Royale Company's location, at Todd's Harbor. The first vein we examined proved to be a stock werke, or irregular vein, without any well-defined walls. The vein-stone, or gangue, is amygdaloid, containing laumonite, calcareous spar, datholite, and native copper, the metal being in pieces of a pound in weight. This copper-bearing rock is fifteen feet wide, and the general slope is to the northward. The second vein is from seven to eight inches wide, runs northeast and southwest, and dips northwest 65°. Two other places had been opened, in one of which copper is found in thin sheets. This vein is a foot wide, and dips to the northwestward 74°. Its course is north 25° east, south 25° west. The wall-rock is shivered into a shingle of slaty appearance, and is disintegrated for the width of four or five feet.

is appears to be a regular vein, and will be opened to ascertain its work-
e value.

August 4.—5 p. m., B. 29.34, T. 19° C.

Todd's Harbor is wide and good, but is somewhat exposed to the north-
st winds. One of the channels is very deep. This location is one of
e most favorable for mining on the northwest shore of the island, but it
yet uncertain whether the work can be pursued profitably. Several
ins containing copper have been found, but they are mostly poor. Mr.
:Culloch, the agent for the company, is still industriously engaged in
ploring the veins, and has a large supply of good specimens, some of
ich he presented to us. We obtained good specimens of prehnite and
tholite. Native silver was found in small quantity at McCargoe's cove
Mr. McCulloch; but we did not find the spot to which he directed us,
vein being beneath the surface of the water.

Continuing our voyage close along to the shore, I observed a number
ravines in which there are probably veins that have never been ex-
red. Those which came to the shore contain but little copper on this
e of the island. At Gull rock we were detained by a strong head
nd, and, while stopping on the shore, opposite that rock, I took a set
observations at and near noon, which gave for the latitude of the place
1′ 21½″, by calculation of the meridional altitude of the sun.

Near Gull rock I examined a vein of prehnite and quartz, with native
per scattered through it. This vein is 18 inches wide, and runs north
° east, south 65° west, and dips to the north 80°. Another vein was
nd which is 4 feet wide, and is nearly vertical. It runs north 25°
st, south 25° west. It contains copper, and intersects the vein before
scribed, near the water's edge. Gull rock cove is a small indentation
the cliffs of trap rocks, and has a gravel beach, on which it is easy to
aw up the boat, so as to render it safe from the waves of the lake.
ere is also excellent camping-ground near to the shore, with an abun-
nce of fir and birch trees to supply bed and fuel.

August 5.—This morning continued our voyage to Washington Harbor.
ree miles from Gull rock we came to the Siskowit Company's loca-
n—Whittlesey agent. It is just occupied, and an exploring party is at
rk. They have discovered some small veins of native copper; but
us far their prospects do not seem to be encouraging. Half a mile fur-
er southwest, we came to another house belonging to Mr. Whittlesey's
mpany—Mr. Benson agent. Nothing has been done here in the way
mining. A short distance from this we saw two other rude log houses
ich were not inhabited. We next reached the Franklin Company's
:ation—J. B Corey agent. This place is 6 miles from Washington
arbor. Mr. Corey has a party of men at work exploring for copper.
e says that his company possess six locations here, and that one of them
claimed by another party now at work at Washington Harbor. They
ve found some small veins of copper, two of which I examined. They
ere from 4 to 6 inches wide, and run north and south. They did not
pear to be valuable, or of sufficient importance to warrant the expense
mining.

We next examined a location belonging to the Isle Royale and Chicago
mpany—Mr. Huganon agent. Stopping at noon at Huganon's cove,
ook altitudes of the sun at and near noon, and the meridional altitude
culated gave 47° 50′ 54½″ as the latitude of the place.

Passing along the north shore of Isle Royale, we found a number of safe landing-places for boats, notwithstanding the representations made of the dangers to be apprehended for want of them. Good gravel beaches are quite common, and many little indentations occur which offer shelter to boats. The trap rocks present bold mural precipices along the whole line of this coast, and are only broken by the little nooks to which I have referred. Mr. Corey accompanied us in his boat from his location to Washington Harbor, and, as we crossed over the bay, he went to one of the small islands where the Franklin Company has a location, while we went to Card's point, and camped near his cabin. The American Fur Company formerly had a location here for siskowit and trout fishing, and had cleared a considerable tract of land and corded up the cut wood, which is now all rotten—the company having soon abandoned the place. I took a set of observations here for latitude and time. (See tables.) At Card's point, near lake level, B. 29.36, T. 16½° C., evening.

August 7.—B. 29.42, T. 19° C., t. 25° C. This day we explored the veins of Phelps's island in the mouth of Washington harbor. Found on this island a house, inhabited by an old man by the name of Isaac Hewitt, and Mr. Wright, an English miner. The two last-named persons were at work exploring a vein, and we went to find them. They were at work for the Ohio and Dead River Company. The Franklin Company also claim this location; but it is not worth contending for—all their veins examined by me having been found to be of no importance for mining. During my stay on Phelps's island I took a meridional altitude of the sun, which gave 47° 50′ 35½″ as the latitude of the place. On examination of the veins, I found them composed of datholite, compact table spar, and prehnite, containing a little native copper. Their course is north 17° east, and dip westward 75°. Three veins occurring near together were each only an inch wide. They furnished some good specimens of copper, but were evidently too narrow to be worked by mining. Beneath the surface of the water we saw some outcropping veins, in which pieces of solid copper projected from the surface of the rock. Laumonite and prehnite abound in nests in the amygdaloid of this island; but the finest specimens are obtained by breaking up the loose boulders on the shore. At lake level, B. 29.455, T. 15° C.

A thunder gust was observed at this time on the north side of the lake; wind southeast. The declination of the magnetic needle at Card's point was 9° east.

August 8.—By meridional altitude of the sun, the latitude of Card's point was found to be 47° 51′ 29″ north. This day was spent in a more thorough exploration of Phelps's island. One of the veins was found to be 2½ feet wide. It runs north 5° west, south 5° east, and appears to be nearly vertical in its dip. Another vein was observed having a course north 10° east, and dips to the eastward. It contains some sheets of copper. All these veins occur close to the water's edge, and cannot be wrought there. It is possible to trace them inland, and to sink a shaft there; but I did not see sufficient reason to justify the outlay of money which would be required.

August 9.—While at Washington Harbor, we explored every location of interest, and visited a place near the head of the bay, where Mr. Card had supposed that a copper vein existed; but it was found to be a decom-

sed rock without copper. We then ascertained the precise spot where e sandstone and trap rocks form a junction—a little south of Card's int, as represented on the geological map of the island which accom- anies this report; noticed a vein of sulphate of baryta at this place, and en doubled the headland forming the southwestern extremity of the land, which is composed of red sandstone, and entered Rainbow cove; opped there to dine and to make some observations. The latitude of ie mouth of a small stream, which empties into the lake by filtering rough a gravel bar, at this place, is 47° 49′ 57″. The rocks here are ndstone, and the shore is low and sandy. A little meadow filled with ll bluejoint grass and equisetacea 2½ feet high, and numerous flowers, eculiar to wet and cold land, attracted our attention. The sandstone cks on this coast dip to the southeast by south 20°, and the course of ie strata is nearly north 60° east, south 60° west.

August 11.—Level of the lake, B. 29.53, T. 16° C., t. 15° C., 9 a. m. We set out for Siskowit bay, passing over tables of sandstone, which bare- allowed our boat to float over the surface, and which extend far into the y. Visited the fishing station formerly established here by the Ameri- n Fur Company, and found Messrs. J. Blackwood, George Bolles, avid Bubee, and Frederick Myers engaged in packing siskowit and te trout. They informed us that they caught, salted, and packed up rty barrels of fish last season, between the months of July and Novem- r, and they calculate to pack upwards of 500 barrels of them this year. his place is of no value except for the fishery, for the sandstone is not etalliferous, and the soil is poor, thin, and sandy. The surface has en thoroughly cleared of woods, and is covered with a thin crop of ass and a tangled growth of raspberry bushes. A short stay at this ace was all that was required. We purchased some potatoes, which ere regarded by us as great luxuries, and then sailed over to a small and, where we camped for the night in a beautiful cove, where our at was sheltered from the high wind, which prevented our going further is day.

August 12.—We are detained on the island by the violence of the wind. t noon, by meridional altitude of the sun, the latitude of this place was und to be 47° 57′ 9″ north.

At lake level, in morning, B. 29.57, T. 19° C.
6 p. m., B. 29.46, T. 17° C.

August 13.—Ran to Datholite, observing where the sandstone rocks rminated, and thus fixed the line of junction of that rock with the trap.— ee geological map of Isle Royale.) At Datholite, at lake level, B. 29.21, . 21° C.; indications of rain. Examined the copper veins at this place, hich is one of the Ohio and Isle Royale Company's locations, and was amed by Mr. J. H. Blake on account of the prevalence of veins of dath- ite. We found a German squatter had taken possession of this place, id had a log cabin near the copper veins. One of the veins at this ace is two feet wide, runs north 60° east, south 60° west, and dips orthwest 50°. Another vein, containing an abundance of datholite, runs orth 35° east, south 35° west, and dips to the northwest. It occurs in e bottom of a ravine eight or ten feet wide; but the vein itself is only few inches wide. Native copper occurs thickly disseminated in them, id perfect rhombic dodecahedral crystals of copper are often found in em.

After making a hasty exploration of these veins, we set out for Rock Harbor, hoping to arrive before the thunder squall, now gathering, should overtake us. In this we were defeated, for soon a most violent thunder storm broke upon us, and forced us to betake ourselves to the first landing we could find. Hastening to the shore, we had just time to throw up our tent to cover ourselves, throw the India-rubber cloth over the provisions, when the rain began to fall in torrents. Our boat was drawn up on the shore, and made an excellent rain-gauge, collecting 150 quarts of rain in one hour. During the squall the Bar. stood at 29.21, T. 18° C., t. 18° C. Soon as this storm was over, we set out again for Rock Harbor, arrived there at night, and set up our tent on an old camping ground in Ransom. The steamboat had arrived during our absence, and had left again. Mr. Ransom's family had arrived and his house was nearly completed.

August 15.—Spent the day in writing. Sent Messrs. Foster and Peabody to examine a cave we had heard of at Scovill's point.

August 16.—Remained still at Rock Harbor writing up journal.

August 17.—Took a series of astronomical observations, and examined the rocks around Rock Harbor.

August 18.—Remained in camp.

August 20.—Examined Conglomerate bay and determined the positions of the rocks and veins. There is a vein containing copper at this place, which had been discovered by one of the explorers for the Ohio and Isle Royale Mining Company. This vein runs ENE. and WSW., and dips northwardly about 85°. It is six inches wide and contains native copper and datholite, mixed up with epidote, which is the principal mineral of the vein. The vein extends to an island about a quarter of a mile distant in a northeasterly direction. Conglomerate, containing agates, jasper, and pieces of scoriaceous trap, is the principal rock at this place. This conglomerate bed overlies the fine-grained sandstone, and is in contact with the trap rocks, where it passes into a breccia and amygdaloid. Both the sandstone and conglomerate are very much indurated, and are cracked, as if by the influence of heat. I observed that the indurated sandstone was divided into rhombohedral prisms, as it generally is where it comes in contact with or near to the trap rocks. Returned at night to Rock Harbor. At level of lake, B. 29.40, T. 18° C.

August 21.—We are hourly expecting the steamboat to take us back to Keweenaw point, and dare not go away for longer than a day.

August 22 and 23.—Made excursions around the bay and to the islands. Examined the eastern side of the bay, where a jaspery vein, containing copper, was observed in the trap rocks in contact with the sandstone. Rowed around the bay and traced exactly the limits of the trap and sandstones.

August 24.—Remained in camp this day, making calculations of our observations.

August 25.—This day I set out on a trip to the central heights of the island along a line previously surveyed by Mr. Leander Ransom, extending from near Rock Harbor to the coast near Fish island. I measured the height of every hill and the depth of every valley on this route to the summit of the trap hills, and then, seeing that there was nothing of interest to examine beyond, measured the section back again to Rock Harbor, examining minutely the rocks on the line of section. On calculating my observations, it was found that there had been a fall in the barometer

ing my excursion. I therefore determined to have a stationary instrunt at Rock Harbor during the next attempt; and being allowed to fill old barometer tube belonging to Mr. Blake, I prepared a stationary trument, and observed it while Mr. Peabody measured the whole secn from Rock Harbor to the opposite side of the island. Mr. Peabody, ompanied by Mr. Foster, then measured this section over again twice, d the results came out very accurately. The calculations being made Mr. Peabody, I drew the sectional profile and committed it to Mr. ster to copy. This section is given in plate 4. I revisited Conglomte bay, in order to connect it with our sectional profile, but had not e to measure the heights through the woods. The land being very el, we have given its approximate height on the profile. For the pure of extending my section to the lake shore, I made a review of the logy of Conglomerate bay. On this excursion we examined more nutely the relations of the rocks, the copper vein having been previousexplored. The sandstone strata have a WSW. ENE. course, and 12° SSE. in general, though they have, in some places, a much higher . By levelling, I found the thickness of the sandstone and conglomte to be 68½ feet, while the trap is 100 feet high. The junction of the and conglomerate is eighty rods from the head of the bay.

On the other side, at the head of Rock Harbor, the horizontal distance ween the trap rocks and the belt of sandstone is 576 feet, the dip ng E. by S. 12°. Rowing up the bay to review these rocks, we iced some drift scratches on a rounded and smooth ledge of trap rock. ese scratches run N. 60° to N. 65° E., and extend below the water el three feet. The rock is rounded off and sloping to the north. At head of the bay, we came to sandstone strata which dip to the SE.; l about thirty yards to the north, we came to trap rock again.

August 29.—Mr. Foster went to see the rocks at Conglomerate bay, th the intention of adding to our sectional profile.

September 14.—For three weeks, we had been most anxiously await- the arrival of some vessel to take us off from Isle Royale, and had olved, against the advice of every one here, to send our boat across the e at any hazards, if the vessel did not soon arrive. The weather had en too stormy to admit of any such movement during the past three eks, and consequently we were forced to remain until the steam vessel ould come. Our provisions had been exhausted, and we were entirely pendent upon the hospitality of Messrs. Ransom and Blake. A large ty of people interested in mines in Isle Royale had been waiting with in a similar manner at Rock Harbor, and all eyes were strained lakeard every day, in hopes of seeing some vessel coming for us. It was, erefore, with great pleasure we this day saw the propeller coming to ck Harbor, and we hastened to pack up our various articles, and made ready for immediate embarcation. We then took passage for Copper arbor, where we arrived on the 15th September.

September 16.—This day is stormy, and we remain at Fort Wilkins d examined and arranged our materials.

September 17.—Examined the mines at Eagle river, which Mr. Corell, agent, had just left, having received orders from the trustees of the ne to discontinue mining operations.

September 18.—Visited the Suffolk Mining Company's location in npany with their agent, Mr. Pray. Satisfied myself that there was no e vein there, but that the gray sulphuret of copper is disseminated in

a bed of trap rock—the rock yielding from eight to ten per cent. of copper. Since no reliance could be placed on such a bed, I advised that no further outlay should be made in working there; but, since the company had collected the materials for a furnace, and a Welch copper smelter had declared he could work the ore advantageously, they determined to make a trial of the ore they had already raised.

September 19.—In company with Mr. Pray, I travelled all over the company's location, examining every spot that presented an opportunity for investigating the geology of that region. Visited the Copper Rock Company's location, where I found a rude log-cabin, with one occupant, who held the location in charge. With him and Mr. Pray, I examined every spot where there was any sign of a vein. Obtained some good specimens of native copper from a beautiful variety of porphyritic trap, having red felspar in crystals scattered through the rock; and gray sulphuret of copper from one of the small veins exposed in the bed of the stream. I did not regard the veins on this location as of any value for mining purposes. The rocks are compact greenstone trap and porphyritic trap, not amygdaloidal, and very hard—the basis of the rock being compact felspar. The veins are all narrow, and are pinched between very hard rocks that are expensive to excavate. Returned to Eagle river.

September 20.—This day I revisited the Copper Falls mine, and re-examined the work. On measuring the course of the vein as it is exposed in the several openings, I found it to be N. 29½° W., S. 29½° E. by the compass, the variation being 6° E. While I was engaged in examining the Copper Falls and the Northwest Company's mines, I sent Mr. Foster to examine the mine of the Northwesten Company. He procured some specimens of native copper, and gave me the following memorandum:

"Copper Falls.—Course N. 29½° W., by compass—Var. 6° E.

"Northwest Company lease No. 8.—Course of vein N. 23° W.; var. 5° E.—John L. Slawson, agent;

on section 24, 60 rods east of sectional line, and ¼ mile south of the north location line. At the bottom of the shaft Mr. S. says is 3 feet; in an adit it is about 6 inches, which will strike the shaft at the depth of 37 feet 2 inches."

On my way from Eagle Harbor to the Copper Falls mine I met Mr. Samuel W. Hill, who handed me a letter of recommendation of himself as a surveyor, the letter being addressed to me by Mr. McNair, the mineral agent. Mr. Hill wished to be employed by me, and I promised to give him some work, and to employ him as surveyor to my party the next year. I learned from him that Mr. Burt, the linear surveyor, was in a vessel becalmed off Eagle Harbor, and that he was very desirous of seeing me. I therefore went back to Eagle Harbor, took a boat and boarded the vessel, and held a long conversation with Mr. Burt and Mr. Higgins, who had seen Mr. Whitney's party on the Ontonagon river, and gave me an account of their proceedings.

September 21.—This day I set out again to examine the mines at Copper Falls, measuring a section from Eagle Harbor to the mines, and while

I stopped there sent a party to examine the Northwestern Company's mine.

At Eagle Harbor B. 29.45, T. 16° C.

One mile from Copper Falls, 9¼ a. m., B. 29.20, T. 19° C.

Office of Copper Falls, 10¼ a. m., B. 29.21, T. 19½° C.

Office of Northwestern Company's mine, 1h. 7m. p. m., B. 28.849, T. 21° C.

First Hill, 3½ p. m., B. 28.600, T. 19° C.

May 22.—This day I measured a section from Eagle Harbor to the Northwest Company's mines, which are under the direction of Mr. Stoutenburg, of New York. In this work I was kindly aided by this gentleman, who afforded me every facility for a thorough exploration of the mines under his care, and entertained my party most hospitably during our stay.

The following are the barometrical observations made by me on my way to the mines:

Level of the lake at Eagle Harbor, 9 a. m., B. 29.412, T. 21° C., t. 21° C.

On Conglomerate hill, one mile from lake, 9 a. m., B. 29.260, T. 22° C., t. 22° C.

Trap Rock Hill, 9 a. m., B. 28.970, T. 21½° C.

Height of land on road, 9 a. m., B. 28.910, T. 21° C.

Summit of hill, 12h. 48m. p. m., B. 28.830, T. 21° C.

Office of Northwest Company, 12h. 48m. p. m., B. 28.845, T. 22° C.

The barometer was allowed to stand long enough to give the same temperature on the attached thermometer as if it had been separate from the instrument. This section was, on returning to Eagle Harbor, measured back again. On examining the declination of the magnetic needle at this mine it was found to be 8° 10′ E. There are several veins on the location belonging to the Northwest Company, and Mr. Stoutenburg, the agent of the company, has opened them far enough to prove that they are very rich in native copper, and that they will prove profitable when the ground is sufficiently opened by mining. Some of the veins contain a considerable quantity of native silver united to the copper and mixed with the veinstone. Owing to want of confidence in the permanency of veins of native copper, the company to which the mines belong has not afforded the means required to render the property productive. The researches of Mr. Stoutenburg have, however, fully proved that the veins are rich enough to warrant the expenditure of sufficient money to open regular mines at this place. From the great number of Indian hammers found in opening these mines, it appears that this spot was well known to the aboriginal tribes, and it is evident that they had worked on the regular veins, and had excavated into them to the depth of five or six feet, beating out the native copper by means of those rude hammers, cart loads of which are seen in the soil around the mine. The first vein I surveyed has a course N. 15° E., S. 15° W. It has been opened by sinking a shaft upon the vein to the depth of 20 feet. This shaft is 8 feet by 7 feet square. The drainage is easily practicable to the depth of 40 feet, by the slope of the land. On measuring the declination of the magnetic needle over vein No. 1 and shaft No. 2, it was found to be 5° 40′ E.

Vein No. 2 was parallel to one already mentioned. A shaft has been sunk upon it to the depth of 50 feet, and a level has been excavated from

the bottom of it to the northward 73 feet and southward 20 feet. The declination of the magnetic needle over this vein was 6¼° E.

The Stoutenburg shaft is now 21 feet deep. The vein is found to be parallel to the two already described. An adit level has been made to drain these veins to the depth of their present working. Its course is north and south, and it opens a vein where the course and dip of the lode could be measured. It was found to underlie 1 foot 2 inches in 6 feet 4 inches. There is a solid sheet of copper exposed in this adit. It is 4 inches thick, and is seen continuously for 10 feet in length. The adit is 165 feet long and meets a shaft, and it will drain the mines to the depth of 67 feet. Some of the masses of copper which were measured in this mine were 6 feet by 7 feet, and were from 2 to 4 inches in thickness. The largest piece of copper that has been raised here weighs a ton.

September 23.—This morning barometer at the office of the Northwest Company stood B. 28.87; T. 10° C. In company with Mr. Stoutenburg, we examined three openings which he had made in the compact trap rock. West of the office, and on the trail to Eagle Harbor, some poor copper veins were found. We then reviewed the mines, and examined the ore heaps, selecting suitable specimens for the government collection. Four shafts have been sunk in searching the copper veins. Three veins are now opened, and on one of them there are 2 shafts 23 feet deep. Thus far the agent has reported to the mineral agent 170,000 lbs. or 83 tons of copper as raised to the surface. He has now 100 tons on the bank. Silver is found in all the veins, but it is most abundant in shafts 2 and 3.

Two shifts of miners are now employed in drifting. They advance 6 feet per week in a drift 4 feet by 6 feet. The cost is about $9 per foot. In sinking a shaft 6 feet by 8 feet, the cost has been $15 per foot. The miners pay their own expenses except for mining tools, which are furnished to them by the company. Mr. Stoutenburg is an active and enterprising man, and has made many important improvements, not only on the location of which he has charge, but also for the public good. He has made a good road 6 miles in length to Eagle Harbor, and one from the Grand Marais to the end of Agate Harbor, 5 miles long, and has cut a trail from the Grand Marais to his mines, 4 miles in length; and in company with the Gratiot Company's men, he has cut a trail to those mines for a distance of 3 miles. He does not profess to be a miner, but has, nevertheless, managed to direct a series of good exploration workings on the copper veins, and has a large quantity of copper, which will go far towards paying the expense which the company has incurred in making these researches preparatory to systematic mining. From what I could learn, I could see no reason why these mines should not prove valuable to the company; but it is obvious that no mine can prove profitable before deep shafts are sunk and proper levels opened, so as to prepare the way for regular stapeing. A large amount of capital must necessarily be expended at some risk in mining, and no operations are so unprofitable as over-cautious half-way measures. No one should say absolutely that a mine will prove profitable, for there are uncertainties about even the most promising mines; but I should consider it as safe to invest capital in this mine as in any other that has not already been proved better.

September 24.—Office of the Northwest Company's mines, B. 28.75; T. 11° C.

Returning to Eagle Harbor, on Conglomerate hill, 11 a. m., B. 29.08; T. 15° C.; t. 16° C.

At Eagle Harbor, 6 feet above lake level, 1 p. m., B. 29.35; T. 17° C.; t. 13½° C.

This measurement is not so reliable as that made on going to the mine, for a rain is now coming on; wind SE.

September 25.—Rainy day; Eagle Harbor, 9 a. m., B. 29.180; T. 22° C.
evening, B. 29.090; T. 22° C.

September 26.—Thick fog. This morning, B. 29 20; T. 17° C.

This day Mr. Joshua Childs visited us, and added some valuable items of information to my statistics of his company's mines. In his shaft, which is 6 feet by 7 feet diameter, the cost of mining, all expenses paid, is $10 per foot in depth. The work progresses from 16 to 17 feet per month in sinking a shaft, and from 20 to 25 feet per month in driving a drift 4 feet by 6 feet. His miners at Copper Falls are now cutting up a mass of copper which weighs 8,000 lbs. They saw it with a fine cross-cut saw, there being no rock mixed with the metal.

September 27.—B. 29.07; T. 15½° C. Heavy rain storm all day; thunder squall in the evening, B. 29.10; T. 15° C.

September 28.—9 a. m., B. 29.170; T. 14° C.
noon, B. 29.114; T. 13° C.

Still stormy weather.

September 29.—I went to the Suffolk Company's mines, 7 miles from Eagle river, in company with Mr. Pray, for the purpose of examining his location. The bed of copper-bearing rocks at the mines opened by Mr. Pray has a course nearly N. and S., and dips 30° eastward. It underlies a hard and very compact porphyritic trap rock, which has a base of compact felspar, and is almost destitute of hornblende, resembling more a true porphyry than trap. On the surface is a thin crust of green carbonate of copper; and when the rock is broken open, it exposes numerous particles of compact gray sulphuret of copper very evenly diffused through the rock. Small string-veins of calcareous spar and of sulphate of baryta are seen in the rock where mining operations have opened it. This copper ore exists in an altered slate rock mixed with trap, which is intercalated in the trap rocks. By the disintegration of this slate, which is much shivered, there is formed a deep and broad ravine, through which a stream, which is a tributary of Tobacco river, runs. It was evident at the first glance that no true vein exists at this place; and notwithstanding the fact that the rock will yield from 4 to 10 per cent. of copper, still it cannot be regarded as proper to erect expensive works on a bed of rock like this, for there is no certainty of its continuing to yield copper to any considerable depth, and the machinery required for working the ore would be very expensive. I therefore advised that no more money should be expended at this mine. Still, it having been represented by a Welch copper smelter that the ore already on the bank could be profitably smelted, the company gave him an opportunity of trying his skill, they having already procured the materials for erecting a small blast furnace. This experiment, as will be seen in the sequel, proved a complete failure.

I learned from Mr. Pray that the leases taken by his company were 101, 102, and 103. They are in township 57, range 31, in sections 9, 10, 11, 12, 13, 14, 15, and 16. After travelling all over these locations in company with Mr. Pray, I visited the Copper Rock Company's location,

adjoining the Suffolk Company's. They have three locations, each of which is one mile square. Mr. Martin L. Punchard is the agent holding possession of these locations. He has built a small log cabin, and has made some shallow explorations for copper, and has found a few narrow veins of the metal and of gray copper ore. I visited them in company with him and examined them attentively, procuring specimens of the metal, ore, and veinstones, with the accompanying rocks. Among the minerals I found at this place are, prehnite in geodes, pink calcareous spar, rhomb spar, native silver, and copper. The rock in which the native copper is found is a beautiful porphyry with bright red crystals of felspar. In this rock a small vein of native copper occurs quite closely pinched. The metal occurs in sheets and in crystals. In one of the veins the gray sulphuret of copper occurs in patches and irregular masses disseminated in calcareous spar. In the amygdaloid the vein is from four to six inches wide, but that in the hard porphyry rock is narrow and the metal is difficult to extract. About three ounces of native silver were taken by Mr. Punchard from one of his openings in these veins.

I learned from Messrs. Pray and Punchard that the red sandstone occurs about three miles SE. from this location; but on searching for it in the bed of the stream where Mr. Pray had seen it, we did not find it, the rock probably being concealed by shifting gravel. After searching these locations I returned to Eagle river and examined a vein on the location of the Lake Superior Company. This vein is situated on the river, and is called the Armstrong vein, it having been discovered by a miner of that name. Its course is N. 10° E., S. 10° W., and it dips to the eastward. It is fifteen inches wide, and consists of a red colored mixture of oxide of iron and calcareous spar, with very rare particles of copper. It widens as it descends, and is in its lowest part two feet seven inches wide. Although it is a regularly walled vein, I do not think it worth the expense of mining, it having a direction which our experience has shown us to indicate in this region a barren vein.

Another vein had been opened since I made my original surveys on this company's location. It is situated a few hundred yards NW. from the office of the company, and was first discovered by a miner named George Knott, and hence is called the Knott vein. It contains native copper, but is narrow, and, alone, would not be worth mining; but it will add something to the products of the location, and the ore may be raised and worked with that from the richer vein in the river's bed.

October 1.—I revisited the Cliff mine, belonging to the Boston and Pittsburg Mining Company, and collected some statistics of their mine, and examined all their works and machinery. Captain Edward Jennings, their present superintendent, is an energetic Cornish miner, and has given by his skill great efficacy to the operations under his direction, so that the mine begins now to yield good returns for the labor and capital invested in it. The old dry stamps put up for experiment have been abandoned, and wet stamps upon the usual principles have been put up in their place, and are doing very well. I examined this mill while it was in operation, and saw the produce of washed copper obtained. The stamp ore is broken into pieces of a few pounds in weight, and is then fed into a hopper through which water passes, and the joggling and current of water carry the ore under the stamp-heads. It stamps its own bed, and the current of water washes out the whole of the pulverized ore and

ıost of the lumps of copper, which are carried into a large tank or vat, here the slime is washed away by the current of water, and the heavy articles of metal and rock remain. The contents of this vat are from me to time removed to *strakes*, and, by stirring it while the water rushes hrough the head of the strake, the lighter particles of rock are removed rom the metal. Subsequent to this the ore is thrown on metallic sieves, nd, by the operation of *jigging*, which is a peculiar agitation of the ieve while immersed in water, the copper and silver are made to settle to he bottom, and the rocky particles are scooped from the surface; and the netals, after being sufficiently cleaned in this manner, are packed up in arrels for shipment. After separating by *jigging* those particles of cop- er and silver which are too large to pass through the perforations in the netallic bottoms of the sieve, the finer particles are to be settled in *kieves*, r tubs, in which the earthy or metallic matters are agitated with water, nd the metals, from their superior specific gravity, settle to the bottom. t is probable that a set of joggling and sleeping tables will be added to he washing machinery hereafter, when a more powerful steam-engine ; employed, that now used being only of ten horses power. It is evi- ent, from what is now doing, that the stamping engine will add consid- rably to the amount of copper and silver shipped by this company, for ıe stamp ore is estimated to contain about eight per cent. of the metals. 'hus far the company has sent to market the richest broken ore, contain- ıg from thirty to fifty per cent. of copper, and masses of nearly pure ıetal—the average yield of the whole being estimated at sixty-five per ent. I was informed by Captain Jennings that the largest mass of cop- er which has been extracted from this mine weighed eighty-three tons. : was cut up into pieces of from one to two tons in weight and sold to ıe Baltimore Copper Company.

At this time the miners receive $10 per square foot of cut surface, ıeasuring on one side of the cut, for dividing the large masses of copper ıto pieces capable of being transported. This expense is trifling when ıe value of the metal and the magnitude of the masses are considered. 'he tools used for cutting up the copper are well-tempered steel chisels, vhich are driven by blows of a sledge-hammer, one man holding the hisel while the other strikes with the sledge. A ribbon of copper, about ıalf an inch in width and from one-fifth to one-quarter of an inch in hickness, is thus cut out quite across the mass of copper; then another ibbon is cut out, and so on, until a mortised channel divides the whole nass. On commencing the operation short chisels are used, whereby nuch power is saved which would be lost in a longer chisel, having more natter to be acted upon, and more elasticity to diminish the effect of the ılow. Chisels of greater length are supplied as the work progresses in lepth, until, in some of the thick masses, one of four feet in length is equired, the copper being in some places from three to three and a half eet in thickness. Various machines have been proposed for the division f these great slabs of copper, but none of them have been found so effi- ient as this first simple method. Those who propose the application of omplicated machinery for the cutting up of this copper should remember hat most of the work is to be done in the deep recesses of the remote alleries of the mine, and that it is not easy to adapt any of their ma- hinery to the standing lode of copper, or to huge irregular masses torn ff and thrown upon the rubbish of the sloping ground and placed in a

position not readily accessible. It is surprising to see with what confidence and earnestness our ingenious mechanics propose to cut up these masses of copper by machinery, and how ready they are to embark in an enterprise from which they would shrink if they knew the practical difficulties in the way. It is obvious, also, that the smallest portion of silicious rock imbedded in the copper or any adherent sand would be an effectual obstacle to the use of steel saws; for the hard silicious rock would imbed in the copper, and would be the most efficient tool for cutting up the saw. If the copper was on the surface of the earth, and free from rock, it would be easy, notwithstanding any weight it might have, to transport it to a mill with circular saws, which would cut it with nearly the same facility they do railroad bars; but from what has been before stated, it will be seen that the conditions in this case are quite different. It was also proposed by a workman from a Welch smelting furnace to melt channels through the standing lode of copper by means of a forge-fire and blast bellows. I objected to this plan, first, that the conduction of heat by a mass of copper would effectually prevent the heating a portion of it to the melting point; and, secondly, that the combustion of the fuel required to melt the copper would produce such a quantity of carbonic acid in the mine as to render the air irrespirable. The first objection was put to the test on the surface of the mine by attempting to melt a mass of copper that had been raised, and it was found impossible to raise a part of it to a high temperature for the obvious reason above stated; hence this project was abandoned. I mention these various schemes to save any persons the trouble of renewing them, or from interfering with the regular operations of the mine by attempts to again introduce methods which have been found impracticable. Captain Jennings informed me that the company made contracts with the miners to excavate levels at the cost of $25 per yard in length.

One hundred and twenty men are now employed at the mines, seventy of whom are regular miners, and are mostly from Cornwall, England. Seventeen houses have already been erected near the mines, and a village will soon spring up there. Already a regular physician is retained at the mines, and is employed by the different working companies on Keweenaw point. A clergyman is from time to time engaged to perform Divine services, and a school will soon be opened for the children of the miners and laborers.

Having descended into the mines, and carefully examined every opening and all parts of the vein, in company with Captain Jennings, I made notes of every fact of importance, procured a good set of cabinet specimens of metals for the use of government, and left the mine, returning to Copper Falls.

I sent Mr. Foster with a party of men to examine the North American Company's mine, near the Cliff mine, and he procured a supply of specimens of copper from that mine.

I saw John Bacon, esq., the superintendent of the North American Company's mines, and procured from him the statistical information I required. The mines are situated on the north side of the west branch of Eagle river, and on the south side of the cliff. The vein of copper dips to the westward; and on the hanging wall of the vein, copper mixed with some silver is thickly implanted. The walls of the vein are well defined, and the veinstone consists of prehinte, quartz, and calcareous spar, which are

ear the surface, separated in part from the walls by layers of red clay, alled by the miners "*fluckan.*" One mass of copper raised from this ine weighs 268 pounds. For want of the requisite funds, this mine was ot opened so promptly as that belonging to the Boston and Pittsburg Company; but now, more confidence being felt in the permanency of eins of metallic copper, the work will be prosecuted more vigorously. Many of the first openings were made merely for the purpose of exploring he ground, and those which are not required in regular mining will be neglected. At present three openings have been made. One shaft is 100 eet in depth, and two others are 23 feet deep. There are also levels of 150 and 240 feet in length. The course of the veins, as given on Mr. Schlatter's plan of the ground, are N. 15° W., and N. 32° W.

During the next summer I shall make a minute examination of this ine, and I trust the ground will be so far opened as to afford a better iew of the vein than can now be obtained.

A hasty visit was next made to the Copper Falls mine, for the purpose f viewing the latest developments of the veins, and in order to procure supply of specimens of the ores for the government collection.

I descended again into the mines, and examined minutely every level nd all the exposures of the vein. Twelve regular miners and ten labor- rs are employed at this mine. Mr Joshua Childs, the superintendent, nformed me that there being no rock in the great mass of copper he had xtracted from this mine, he was enabled to cut it up by means of a cross- ut saw, at a cost of only $6 per square foot of cut surface. The largest ass weighed 7 tons, and it cost $75 to cut it up into pieces which could e transported by wagons to Eagle Harbor, where it was shipped and sent o Boston.

I examined, during this visit to these mines, a number of barrels of a reenish decomposed mineral found in the vein, which is largely mixed ith native silver, some of the pieces containing from $25 to $100 worth f silver per hundred weight of the rock. This rich ore was obtained om the vein near the junction of the trap rock and sandstone, and it is enerally observed that silver occurs most frequently and in larger quan- ities near the surface of the veins and near the line of contact of sand- tone and trap, as also in the crossings of veins or at the points where *feeders*" come in. The ore from those points ought to be picked out nd worked separately for silver. It should be stamped and washed at he mines, and then the metals should be packed in barrels and sent to he refiner for the separation of the silver from the copper.

The richest specimen I obtained yielded 5 ounces of silver per 6 pounds f the veinstone. The average yield on a large sample I have not been ble to obtain, since no such sample has ever been drawn, but the barrels f ore I have mentioned were sent away.

Thus far no machinery has been put up at this mine except a horse hinn, used for raising the ore and water. If the work is to be success- lly prosecuted, a steam engine of twenty or thirty horses power should e employed, and more extensive openings should be made. It is not yet nown whether the mine will pay a profit to its owners or not, for all the eans required for the development of its resources have not yet been t in action.

The most discouraging geological feature which here presents itself is e occurrence of a bed of fine red sandstone, which, from its dip and di-

rection, must cut off the vein, and will render it unprofitable. This bed was surveyed by Mr. Childs and myself, and was estimated to be 75 feet thick. Beneath it the trap rock again occurs, but it is not certain that the vein in the upper trappean bed extends into the trap rocks below. This point is to be tested by Mr. Childs next year.

Several veins occur on the location of this company, and have been fully surveyed by their agent, but they have not yet been proved. It has been proposed to run an adit level from the hill side into the shafts which have been opened, in order to effect drainage, but, since the work will be all in barren ground, the company hesitate as to incurring this expense. The short adit will prove very useful, and will be made, if the produce of the mine should be deemed sufficient to justify the outlay of the money required. It is not probable that the long adit will ever be made.

I requested Mr. Childs to furnish me with a plan of his mine, which he very kindly consented to do. He has made regular surveys and kept plans and sectional views of all the work he has executed.

After making this last review of the mines for this season, I went to Eagle Harbor and Copper Harbor, and embarked for home on the 3d of October, reaching Boston about the middle of the month.

I immediately prepared my synopsis of the labors of the season and forwarded it to Washington, with the annual reports of my assistants, as soon as they were received. These synopses were printed in the report of the Commissioner of the General Land Office.

The winter months were devoted to analytical and metallurgic researches, applicable to the working of the metals and ores of Lake Superior, the results to which I have arrived being contained in this report.

Journal of the Geological Survey for 1848.

Having written to the Treasury Department several times during the spring months for the remittance to me of the funds required for the survey, and for the balance, $1,500, due to me and my party for the last year; and not having received this remittance, on the 2d June I went to Washington to learn the cause of this delay, and to obtain the money required.

On arrival there I learned from the Commissioner of the General Land Office that the appropriation for the survey was endangered by certain representations which had been made to a member of Congress by persons opposed to it, or by persons who wished to supersede me, by limiting the appointment to a citizen of Michigan.

I was informed of the nature of the complaints made, and found that they were charges against my *assistants* for neglect of duty in the field. To these charges I made a reply, which was deemed satisfactory, and the objections to the passage of the appropriation bill were withdrawn.

I then procured the funds required for setting out on the survey, paid up all the members of my corps, and advanced them the money necessary for their outfit and travelling expenses to the lake. On the 15th of June I sent forward a party of my sub-agents to Detroit, to purchase supplies, and followed them myself with the remainder of my corps on 20th June. The interruption I had so unexpectedly met with by having been obliged to go to Washington, and the haste with which I had to

lake preparations, caused me to forget to obtain some apparatus which I was desirous of procuring for the purpose of searching for galvanic currents in the copper veins. This was a cause of serious regret when I arrived at the mines, for I had calculated to settle the vexed question of the existence of any such currents. It was impossible to procure the materials required for the construction of such apparatus on Lake Superior, and hence I was delayed another season in those researches so interesting to science, and thus far untried in this country. In mines free from sulphurets, such as the native copper veins of Lake Superior, these experiments could have been tried where the objections urged against the experiments of Mr. Fox, of Cornwall, could not be applied, and therefore interesting results might be looked for. In every other respect, I was well equipped for my labors. The honorable Secretary of the Treasury had allowed me to procure two chronometers, so that the difference of longitude between Boston and Lake Superior could be determined. One of the chronometers was confided to Mr. Whitney, who had been instructed in the use of the sextant, and the other was used by me. It was hoped, if another season was allowed for the survey, that by two journeys with these chronometers to Lake Superior and back again a near approximation to the true longitude might be obtained; and the latitude observations previously made by me, connected with a new series of longitude observations, would fix the geographical position of every important point on the lake. I would observe, however, that these geographical measurements formed no part of my duty; but I was desirous of contributing to that department of knowledge, since it could be done without taking up much of our time, and could not fail to prove interesting.

I was provided with a good French sextant and mercurial horizon, and one of my friends had loaned to Mr. Whitney a good English sextant and artificial horizon. I had been accustomed to astronomical observations with such instruments for several years, and Mr. Whitney had also had some practice while he was in my employ in the geological survey of New Hampshire, and had learned to use the sextant. I had procured four good mountain barometers, all of which were perfectly accurate, and Messrs. Whitney and Gibbs had each one of their own. These, with thermometers, numerous compasses, measuring chain, tapes, all the mineralogical instruments, tests, and the geological tools, were provided by me from the best instrument makers, and at my own expense. Boats and camp equipage we had left last season at Copper Harbor, all ready for our use on reaching that place.

The following is a list of persons employed by me on the survey for this season:

Josiah D. Whitney, of Northampton, Massachusetts, } Assist. geologists.
John W. Foster, of Zanesville, Ohio, }
Samuel W. Hill, of Michigan, surveyor.
William Schlatter, of Eagle river, Michigan, draughtsman for maps, &c.
Dr. Walcott Gibbs, of New York, sub-agent.
George S. Dickenson, Boston, Massachusetts. }
George O. Barnes, Plymouth, do } Assistant sub-agents.
James McIntyre, Bangor, Maine, }
J. A. Joy, New York, clerk and packman, &c.
C. W. Thayer, Cambridge, Massachusetts, packman for instruments, &c.
Joseph S. Kendall, Boston, Massachusetts, observer of stationary barometer.

Dr. John Locke had been detached at his own request, and by the advice of the Hon. Secretary of the Treasury, to make magnetic observations on both Dr. Owen's district and mine; but, owing to the lateness of the passage of the appropriation bill, did not enter upon field duties this year. The appropriation bill not passing until August, it was considered then to be too late for the beginning of Dr. Locke's field duties, and the means placed at the disposal of Dr Owen and myself were not sufficient to maintain that survey until the appropriation should be placed at our disposal. This was a matter of regret, for the magnetic observations had already begun to yield interesting results.

June 25.—This day we reached Detroit, and stopped there two days for the purpose of consulting with the surveyor general, and making arrangements with him for transmission to me of the township plats as soon as they could be drawn. I also made arrangements with C. C. Trowbridge, esq., to receive for me the funds I might require.

June 27.—We embarked for the Sault Ste. Marie, and reached there on the 29th of June. We were detained there until the 7th of July, awaiting the sailing of the propeller "Independence," her machinery being out of order, and the captain had gone to Detroit for materials to effect repairs. During this stay at the Sault, I directed a series of astronomical observations required for rating our chronometers, and for the determination of the longitude of that place. Mr. Whitney was charged with these observations.

July 7.—We left the Sault for Copper Harbor, and arrived at that place on the 8th.

July 9.—We remained this day at Brockway's house, engaged in making preparations for our work and in writing to the Treasury Department.

July 10.—Removed all our effects to Fort Wilkins, and, after arranging our articles, made a set of astronomical observations.

July 11.—Repaired those instruments which had suffered injury on our journey, and also made astronomical observations for rating chronometer and for longitude of Fort Wilkins.

July 12.—Surveyed the borders of Copper Harbor, and sent Mr. Barnes to measure Brockway's mountain.

July 13.—Filled Mr. Whitney's barometer, putting the instrument into complete repair; then went to Manganese lake, three miles back from Copper Harbor, to measure its height, examine the locality of black oxide of manganese, which gives the name to the lake, and to collect some new species of shells discovered there some years since by Captain Benjamin Stannard.

The hill directly in the rear of Copper Harbor is composed of conglomerate rock, and contains a vein of calcareous spar which has been mistaken for a continuation of the black oxide of copper vein formerly mined at Copper Harbor. This hill contains no minerals of interest, and is covered with a thin and poor soil, from which the vegetable mould has been burnt by a recent fire, and the fallen forest trees, half burnt, are in great confusion. On reaching Manganese lake, we saw the bed of manganese near the falls, fifty yards below the outlet of the lake. It is in a bed of calcareous spar included in the conglomerate rocks which present themselves in overhanging crags on the borders of the stream. The manganese is a silicious black oxide, much mixed with calc spar, and is of no

alue for the arts. The layers of manganese are three or four beds of from one to seven inches in thickness, and included in the spar. The middle layer is the thickest. The conglomerate rock dips to the northwestward 13° or 15°, and the cliff is 40 feet high.

Manganese lake is a small but very pretty sheet of water, quite warm at this season of the year, and is inhabited by myriads of fresh-water shells and leeches. The elevation of this lake, as determined by barometrical observations, is 141 feet above the level of Lake Superior.

Level of Manganese lake, B. 29.36, T. 73½° F., t. 67° F.

26 feet above Lake Superior, B. 29.48, T. 73½° F., t. 70° F.

The immediate fall at the outlet of the lake is only 8 feet, and the stream s small.

We picked up a pint or two of the shells, and packed up a number of pecimens of the manganese and calcareous spar, and then returned to ort Wilkins.

Mr. Samuel Hill, one of the deputy linear surveyors, whom I had romised to employ as our surveyor, came and joined us this day.

July 14.—I set out with my party to review the geology of Keweenaw oint, and to fix certain lines of junction of the trap and sandstone by the ownship lines. I then was to send my boat back to Fort Wilkins, and urvey a section from Lac la Belle to Copper Harbor.

Dr. Gibbs went with me, to try his barometer with mine, on this route. Stopped at Horse-shoe Harbor, and sent Mr. Barnes to measure a hill in he interior—which he accomplished, and also obtained specimens of the ocks.

Barometer at the lake, B. 29.60, T. 68° F.

Barometer on the hill, B. 28.92, T. 68° F.

The height is 712 feet.

We were detained a few hours by wind at Horse-shoe Harbor, and topped to dine there. Soon as the wind had abated, we continued our oyage along the coast, marking on the spot the exact positions of the ocks—Mr. Barnes seeking the marks of township and section lines, so hat we could denote their locations on the township plats, which were to be reduced by our draughtsman into a geological map. Mr. Foster and nyself were engaged in the mean time in measuring the dip and direction of the strata, or in collecting specimens of the rocks and minerals which re found on the coast.

At the extremity of Keweenaw point, the trap rocks are quite strongly mygdaloidal, and form regular beds with the conglomerate and sandtone, and project beyond these rocks into the lake. Agate pebbles are bundant, and are derived from the disintegration of the amygdaloid, and lisengagement of these silicious amygdules. Some large geodes of agate were observed, but it was impossible to extract them whole without blasting the rock. Radiated pectolite, variously colored, occupies some of the avities in the amygdaloid.

After marking on our township plats the position of each rock—Mr. Barnes seeking out the section lines, and Mr. Foster recording the places n the map; while I explored the geological boundaries, and collected speimens of the rocks and minerals, measuring the dip and direction of the tratified rocks—we passed along the shore to the Massachusetts location, which has been abandoned after a fruitless search for copper veins. Six ouses have been erected on this spot, and the soil has been cleared, and

is of good quality, as is shown by the luxuriant growth of barley and herd's grass which have been accidently sown near the houses.

We stopped a short time at the Boston and Lake Superior Mining Company's location, situated near that belonging to the Massachusetts Company. It has been abandoned, after an unsuccessful search for copper veins. The houses built for the mining party are in good order, and a considerable clearing has taken place around them. We visited next the mouth of Little Montreal river, and examined the rocks for some distance up that stream. This river falls into the lake over ledges of trap rocks, by a succession of leaps—the aggregate height of these falls being about 40 feet. Further up the stream, there are other minor falls and rapids. The rocks are hard and compact trap rocks, but slightly vesicular. No copper veins are found at this place, or any mineral of interest.

Continuing our voyage to Lac la Belle, we noticed a peculiar breccia of porphyry and trap rock, which, at first sight, would be mistaken for conglomerate rock. It contains a large mixture of seams of leonhardite, some of which is of a bright red color, from peroxide of iron. Further towards Lac la Belle, we came to nearly vertical strata of sandstone, the dip being NE. 85°. The range of the outcrop, according to Mr. Foster's observation with a prismatic compass, is N. 70° W.

We next entered Lac la Belle in our boat, passing over a sand bar at the mouth of the river, and sailed up that beautiful stream to the lake which the ancient French *voyageurs* so properly named Lac la Belle. It is indeed a very beautiful sheet of water, spread out directly beneath the Bohemian mountain and Mount Houghton, and covering an area of about two miles square.

Previous to ascending the mountain, I took a barometrical observation, the instrument being suspended three feet above the surface of the lake, as recorded below.

July 15.—Three feet above the level of Lac la Belle, 3¼ p. m., B. 29.57, T. 22° C., t. 67° F. Ascending immediately to the office of the Lac la Belle Mining Company, B. 29.265, T. 20° C., t. 68° F.

From this observation, the height of that spot is 306 feet above Lac la Belle.

We next examined the adit which had been made since I last visited these mines, with a view to striking the vein at a lower level, and to drain the upper works. This adit is 114 feet below the office, and is a most beautiful specimen of the miner's skill; but it does not appear thus far to have rewarded them by disclosing a rich lode of copper ore, which it was hoped would be cut by it. Indeed, there is a high probability that it has not reached the veins which have proved so rich in copper higher up the hill. A vein consisting mostly of calcareous spar, with an admixture of gray sulphuret of copper and some small string-veins of the ore, is all that has thus far been found in this adit. This vein is 3 feet 9 inches wide. It dips from 74° to 81° W., and follows the line of junction of a red shale with the hard trap rock. Near the mouth of the adit, the rocks consist of a curious variety of chlorite slate, which is a soft rock, easily cut by the miners' tools. The adit runs through this soft green rock, and then through a red slate, and divides into two branches or forks, driven to seek for the vein. The distance from the mouth of the adit to the forks is 158 feet; from thence one branch runs 94 feet to a vein, and 160 feet on the vein—making in all 412 feet as the extent of the excavations. But little

e is now exposed to view in this mine. The vein became pinched as it as followed, and is not rich enough to pay for the work. Some bunches id small rich veins have been found, but they were quite irregular and ncertain. I measured the temperature of the air and water in this adit, id found, at the depth of 179 feet below the surface of the ground, the mperature of the air was 48° F., and of the water 45° F., while the cternal air was 71° F. At the depth of 140 feet, the temperature of the ater was 44° F.; a second experiment, in another spot, gave 44° F. he temperature of the air at that place was 51° F., the external air being 71° F. I then examined the upper drift, which runs NW. and SE., id enters the hill above the office. The temperature of the air in this ift was 47° F., and that of the water was 44° F. After making these periments, I re-examined the vein, and found it to dip to the NE. It is narrowed to 1½ inch in width. I examined also 50 barrels of ore hich was extracted from this mine. Each of these barrels of ore was timated to weigh about 500 lbs. The ore is a mixture of gray sulphuret copper, mixed with some pulverulent carbonate, and will probably yield om 45 to 47 per cent. of copper. A working sample of a few tons of is ore was assayed by me in Boston previous to my visiting the mine.

I went next to revisit the Bohemian Company's mine, further up the ll, and found the works had been abandoned, on account of a fire which id destroyed all their buildings and the machinery at the shaft. Seven ouses had been consumed. Mr. Mandlebaum, the agent, had left for ew York, and no opportunity was afforded for a new inspection of the ine.

July 17.—This morning we took some observations, and then set out measure a section from Lac la Belle to Copper Harbor.

At Lac la Belle Company's office, 8½ a. m., B. 29.10, T. 20° C.

Near a brook and ravine running S. 20° E., 10 a. m., B 28.88, T. 22° ., t. 69° F.

Montreal river, 10¾ a. m., B. 29.12, T. 22½° C.

Ravine, base of ledge, 11¾ a. m., B. 28.92, T. 24° C., t. 71° F.

Under ledge, 12 m., B. 28.915, T. 22° C.

At this place, saw a small vein with a little copper. It had been explored by Mr. Mandlebaum. This vein runs N. 30° W.

Bridge 8 miles from Bohemian mount, 1h. 10m. p. m., B. 29.01, '. 22° C., t. 70° F.

Reached Brockway's house at 2 p. m., and then went to Fort Wilkins.)r. Gibbs, my sub-agent, measured several points with me, with his arometer, completing by this means an entire line of section over the hole route to Copper Harbor. The results of this measurement, calcuated, gave the sectional profile shown in plate 5.

July 18.—This day the observations were calculated, and the section as drawn by Mr. Foster, my assistant.

July 19.—This day I sent Mr. Whitney and Dr. Gibbs, with Mr. Joy nd three of our best boatmen, to explore the country on the Ontonagon ver, and to eastward as far as the portage on Keweenaw point. They re to spend a month in exploring the mines and in making such observaons as may be required. He is to carry one of the chronometers and ie sextant, and determine the longitude of a few points on his route.

Having engaged Mr. Wm. Schlatter to draw a map of Keweenaw point om the township plats in my possession, for a basis on which the geol-

ogy of the point should be represented from my surveys, I remained a few days to superintend the work, and sent Mr. Barnes out to measure the heights of several mountains in the vicinity. He explored a line of section to the Montreal river, and on his return brought a very singular trap rock, composed of crystals of a black mineral which proves to be pyroxene, and specimens of prehnite and pieces of rock he met with on his route.

July 21.—A high north wind prevents my sending out a party in the boat this day. We therefore remained, being occupied in writing, &c.

July 24.—This day, the wind having diminished, we set out for Eagle Harbor and Eagle river, where I found letters from Washington awaiting me. Went to Eagle river, and left our luggage at the Lake Superior Company's office, and then went to explore the Suffolk Company's location in company with Mr. Lyman Pray. I sent Messrs. Foster, Hill, and Barnes to explore the country to Torch lake.

At the Lake Superior Company's office, which is — feet above the level of Lake Superior, 3 p. m., B. 28.98, T. 20° C., t. 68° F.

Top of hill, one mile north of Mr. Pray's house, on the Suffolk Company's location, 4¾ p. m., B. 28.48, T. 21° C., t. 68° F.

Mr. Pray's house, 5 p. m., B. 28.64, T. 20° C., t. 66° F.

One of my principal objects in this visit was to examine the furnace which Mr. Pray had erected, and to witness his experiments in smelting the copper ore which he was endeavoring to reduce. I also examined the different openings he had made on the location belonging to the Suffolk Company.

July 25.—This morning at Mr. Pray's house, B. 28.96, T. 22° C., t. 62° F.

Examined the location lease 102, travelling over a large portion of that region and the locations adjoining, in order to explore for the junction of the trap rocks and sandstone. On lease 102, I examined a vein of calcareous spar containing a little gray copper ore. A drift has been driven into it in a course north 30° west, and has exposed a vein four inches wide, which dips 76° northwest. At this mine the barometer stood, B. 28.98, T. 15° C., t. 56° F. After traversing a table-land thickly covered with maple, birch, and pine trees, we returned to Mr. Pray's house, where the barometer at 3 p. m. was, B. 28.962, T. 18° C., t. 76° F.

July 26.—Examined the furnace, made a drawing of it and the steam-engine and blowing-machine, and saw the ore smelted. I observed that more iron than copper was obtained by smelting this trap-rock in the blast-furnace, and that it was not a suitable furnace for smelting copper ore. The temperature required to melt the rock into a liquid slag, even when well fluxed with lime, reduced the iron, which is a constituent of the rock, so that the pigs cast were nearly three-fourths of their thickness made up of cast-iron, which floated on the surface of the copper in casting. I therefore advised abandoning the idea of working the ore, for it was obvious that it could not be worked to advantage. It was not worth the expense to put up stamping and washing mills, and the copper could not be separated from the rock without this was done. Mr. Pray resolved, therefore, to abandon the place immediately. The copper which he had reduced was separated from the iron by refusion, and a cake of it was obtained quite pure by taking advantage of their different specific gravities, and running off the iron from the surface of the melted copper.

July 26.—At Mr. Pray's house, B. 28. 84, T. 15° C., t. 55° F.; at 11 a. n., B. 28.82, T. 16½° C., t. 61° F.

After making an examination of the ores from the mines on the Suffolk ocation, and stamping and washing a fair sample, which gave 6 per cent. of pure gray ore as the result, I invited Mr. Pray to accompany me to the Buffalo and Northwestern Company's locations, where I had not yet been. On this excursion I measured the height of every place of interest, preparatory to representing the contour of the country by a sectional pro-ile.

Leaving Mr. Pray's house, we ascended a hill north by west from that place, and one mile distant. The barometer stood at that place at noon, B. 28.42, T. 17° C., t. 52° F. Descended this hill and travelled through he woods to the Buffalo location, lease 137. This location is under the are of Mr. George Durand, whom we found at the house, and who indly received us. At this house, 1h. 10′ p. m., B. 28.565, T. 16° C., . 65° F. Examined the works at the mines which had been opened. The shafts were full of water, and the mining operations had failed to give any hopes of success. A few specimens of the ores were obtained, which were gray sulphuret of copper and native copper, sparingly scattered through the rock. The shaft was 40 feet deep, and the ores raised were seen around its mouth. The rocks are trap, and are hard, and not ufficiently. metalliferous to render the location valuable. The soil is ood, as it generally is on these rocks, and timber is quite abundant.

Leaving the Buffalo location, we next travelled through the woods to he Northwestern Company's location, which is in charge of Mr. J. Slawson. We did not find him at the mines, but we had an opportunity f examining the works, and obtained a few specimens of the metals, ocks, and minerals found in the mines.

At Mr. Slawson's house, 3 p. m., B. 28.71, T. 18°, t. 61° F.

The first vein of copper I examined was from two to eighteen inches ide, and quite irregular, but has furnished some tolerably large masses f pure copper. An adit 300 feet in length has been excavated on this ein, and is penetrated by a shaft 30 feet in depth. The minerals I ob-erved among the ore were native copper, leonhardite, laumonite, epidote, rehnite, and quartz. The copper occurs in sheets and in disseminated articles in the veinstone. At the principal shaft the vein is quite rich, ut the adit gave only poor returns. The upper shaft, 58 feet above the dit, is in a poor vein, and is only 20 feet deep. A new shaft 20 feet deep as been made above this, and is 88 feet above the adit level. Several ther shallow openings have been made higher up the hill, but none of hem thus far give any promise of being worth continuing to any greater epth, numerous string-veins only presenting themselves in a hard trap ock. A great many Indian hammers were found in the soil, near the pot where the native copper occurs on this location. They are made of hore pebbles weighing 8 or 10 pounds, and are generally of a compact ock, composed of hornblende and felspar. They have an oval form, nd in the middle there is a groove cut for affixing a withe, so as to form handle. The presence of these tools shows that the Indians were in he habit of frequenting this place for the purpose of obtaining copper. The soil on this location is good, and a clearing has been made and cul-ivation begun. The forest trees are mostly hard wood, such as maple, ellow birch, and ash. The mine appears to be neglected for want of

means of exploring it to a depth sufficient to prove this vein. The ground is very favorable for mining, and some parts on the vein have yielded sufficient copper to encourage a more extensive exploration. After examining this location as thoroughly as was deemed necessary, we returned to the Buffalo location, and then to the house of Mr. Pray, on the Suffolk location. I then assayed a sample of the ore from the heap at the furnace, and obtained, from 2¼ pounds of the ore, 2¼ ounces of pure gray copper ore,=6¼ per cent.

July 27.—This day we proposed visiting the Michigan Company's location; but, just as were going, Mr. Robinson, the gentleman who had charge of that location, arrived, bringing with him all his effects, and said that the location was abandoned, and that, after careful search, they had found nothing worthy of examination.

July 28.—At Mr. Pray's house, 9 a. m., B. 28.92, T. 18¾° C., t. 63° F. Returned to the Lake Superior Company's office, where at noon, B. 29.32, T. 19° C., t. 64° F. From these data a sectional profile was obtained.

July 29.—This day took observations for determining the time at this place, and for rating chronometer; also latitude observations.

Messrs. Foster and Hill were sent to Copper Falls to obtain a set of specimens of the ores and minerals.

July 30.—Violent south wind and rain. Mr. Hill is engaged in making rough plans, and Mr. Foster in drawing them. Mr. Thayer is calculating my last observations. At 3½ p. m, B. 28.875, T. 20° C., t. 68° F.

July 31.—Wrote up journal and examined minerals while the drawing of plans was going on.

B. 28.87; T. 22° C.

August 1.—At 9 a. m., B. 29.09; T. 18° C.; t. 65° F.

This station 246 feet above the level of Lake Superior.

August 3.—At 10¼ a. m., B. 29.143; T. 21° C.; t. 71° F. Proceeding to the Cliff mine—

At the office of the Cliff mine, B. 29.02; T. 23° C.; t. 75° F.; height above L. S. Co.'s office 158½ feet.

The height of this place above Lake Superior is 404½ feet. During this visit to the Boston and Pittsburg Company's mines I examined the pieces of copper cut from the great mass of 83 tons weight; one of the pieces is of the following dimensions: 4 feet 8 inches × 3 feet 2 inches × 1 foot. This piece weighs 3½ tons. After inspecting this mine, and taking observations of the barometer, which stood, at 2 p. m., B. 28.99, T. 24° C., t. 75° E., I went to the North American Company's mine, where, at 2¾ p. m., at the office the bamometer stood, B. 29.00; T. 25° C.; t. 77° F.; it is, therefore, nearly on a level with the Cliff mine, or but 30 feet above it.

The North American Company's mines are quite promising, and the preparations for deep working are properly constructed. Two shafts are now opened, and are well timbered, and a good horse whinn has been erected for raising the ore from the mine. The principal shaft is 150 feet deep, and cuts through a vein a foot in thickness, which is rich in copper, and contains some silver. The average stamp ore yields 5 per cent. of a mixture of metallic copper and silver in coarse grains. The fine particles were not saved, as the stampings were washed only in a *strake*. These mines I examined more fully at a subsequent visit. I intended at this time only to make a cursory examination of them, and to go to the other mines

to-day. I therefore continued my journey to the Albion mines, where we met with Mr. Stevens, the agent of the company.

At the Albion mines, 5½ p. m., B. 28.845; T. 24° C.; t. 74° F.

This point is 614 feet above Lake Superior. The Albion Company has abandoned mining operations on this location—all the veins opened having proved worthless. Their agent has, therefore, turned his attention to sawing lumber for supplying the neighboring locations, and is doing a good business. All their old shafts being full of water, I was unable to do more than to examine the work they had raised to the surface, which was sufficient to indicate the propriety of abandoning all attempts at mining here.

The Medora Company purchased of the Albion Company a part of their location, and attempted mining, but failed to discover any vein of value. I examined the places where they had worked on the cliff. A vein of calcareous spar, quite free from copper or any ore, was a foot and a half wide, and contained leonhardite, in beautiful flesh-colored crystals.

August 3.—At the Medora mine, at 6 p. m., B. 28.67; T. 23° C.; t. 70° F. Crossing over the summit of the cliff, and descending a few rods on the slope, we came to a little vein which was supposed to be antimonial copper ore, but which by blow-pipe analysis gave only arsenic and copper. The vein is only 1½ inch wide, and contains merely a few small specks of the ore, so that I could not obtain a sufficiency of it for quantitative analysis. This little vein runs N. 31° W. The cliff, according to the measurements of Mr. J. T. Hodge, who originally surveyed this location for the company, is 840 feet above Lake Superior. After completing my examination of these locations I returned to the Lake Superior Company's office at 10 p. m., where the barometer stood B. 29.110; T. 21½° C.

August 4.—Revisited Copper Falls mines for the purpose of making some further researches and experiments in the mines. I was desirous of repeating my experiments on the temperature of the mine, and on trial found that the temperature of the water at the bottom of the shaft, 130 feet from the surface, was 44° F.

Temperature of the air in the mine, 48° F.

Temperature of the external air, 64° F. Mean temperature of the place = 42°.12

During this examination of the mine I ascertained more particularly the fact that the thick sheets of copper occur mostly on the east wall of the vein, and that the silver is not limited to either wall, but occurs most abundantly near the junction of the sandstone and amygdaloidal trap, and generally in the green veinstone, which follows the junction of the two rocks. In the middle of the shaft, the dip of the vein was ascertained to be SW. 51°. Mr. Childs, the agent, informed me that he came to the sandstone rock in sloping 100 feet north, and that the vein occurs in the sandstone, but contains very little copper. I obtained from Mr. Childs some crystals of apophyllite, which were found in the mine; and also some large foliated masses of the same mineral from the Prince mine, on the north shore of Lake Superior, with several good specimens of amethystine quartz and brown blende.

August 5.—Sunday morning left for Eagle river, and in the afternoon went to Mr. Pray's, and in the evening returned to Eagle river.

August 6.—Wind high, so that we cannot go to the Portage, as we proposed, this day. Remained at Eagle river and took some observations.

August 7.—Still detained by high winds and a heavy sea; employed my time in observations, and in collecting minerals from the rubbish thrown out from the exploration shafts which have been made on this river.

August 8.—Examined the vein called Sheffield and Nott's vein, having been dicovered by those miners. It is in trap rock, and is from 6 to 11 inches wide, and contains both copper and silver. It is situated 50 rods west of the office of the Lake Superior Company, and runs S. 20° E., and dips eastward 70°. It is supposed to be a continuation of the vein found by Mr. Childs at the three falls of Eagle river. Mr. Hill surveyed its course with the solar compass, and it was found that the line came out 300 feet north of that spot. We found Indian hammers in the soil around this opening; hence it was worked by the aboriginal tribes. I took one of the hammers found and collected a set of specimens of native copper—one of which contains silver. Took a meridional altitude of the sun, and on calculation of the observation, Mr. Thayer informed me that the result agreed within half a second of the result I had obtained in a previous observation. At noon, B. 29.04; T. 26° C.; t. 79° F. In the afternoon I examined a cliff two miles south of this place, where Mr. Douglass, while in the employ of the Lake Superior Company, had carried forward some exploration drifts. The veins are all barren. One of them runs N. 12° W., and dips ESE. 78°, and is 4 inches wide. The cliff is about 50 feet higher than the hill at the Northwestern Company's location, as observed by a level made by a plumb-line and rule; but not having brought the barometer, we could not measure its exact height above the lake. We examined the rubbish thrown out from numerous openings made under Mr. Douglass's direction, but found no copper. Returned to Eagle river, passing along a deep ravine, where numerous excavations had been made for copper, but without success.

August 9.—The wind having subsided, we set out for an examination of the northwest side of Keweenaw point to the Portage, following closely the shores, and examining every rock on our way. On going from our office to the shore, the barometer levelling was verified by new observations. At 6 a. m., at office, B. 29.19, T. 17° C., t. 65° F.; one foot above the level of the lake, 9 a. m., B. 29.470, T. 21½° C., t. 65° F.

The height of the office above the lake is $246\frac{7}{10}$ feet, differing less than a foot from the measurements by a spirit-level. We set out at 9 a. m. for the Portage, landing at every spot where any change was observed in the appearance of the rocks. About a quarter of a mile south of Eagle river the conglomerate rock is seen on the coast. The shore is sandy a mile north of Hitz's point, and trap rock comes in about one-eighth of a mile north of that point. Passing along a sandy shore south of that place, we observe next a rocky point composed of trap rocks, broken and disjointed. This bed is two hundred yards wide, and is regarded as a continuation of the trappean band which borders the lake, near Eagle river. Mr. Hill landed here, and walked along the shore to look out the township and section lines, to guide me in marking the geological boundaries on the map. Passing this sandy cove, we came again to a belt of trap, from four hundred to five hundred yards long. Landed at the Lake Shore Company's

cation, where Mr. S. Ketchum, of Michigan, had caused some explora-ons to be made, but found no copper-bearing vein. There are two beds f trap rocks, highly amygdaloidal, and of a red-brown color, containing ests of calcareous spar and red leonhardite. The shaft which has been unk here is full of water, but the rocks thrown out show that it was unk into a vein of calcareous spar, free from copper. This shaft is made n the rocks, fifteen feet above the level of the lake.

We came next to a stream, formerly named by the voyageurs Eagle iver; but this name having been transferred to another stream, a new ame should be given to it. This stream is barred at its mouth by a bed f coarse sand and gravel, and the water finds its way through it by filtra-ion. The stream is narrow, and, like most of the tributaries of the lake, ontains an abundance of brook trout. At the point beyond this stream he red sandstone strata appear, and dip to the southwest 20°. Directly in he rear of this rocky shore is a long line of swampy land.

We next came to a small stream which has no name, but which we alled Porcupine river. Fine stratified red sandstone is here seen along the ast. The strata run south 15° west, and dip southwest 22°. At 6½ . m. we reached the Portage, and camped there for the night. This port-ge is the carrying place, over which the Indians and voyageurs transport heir canoes to and from Portage lake, and thus save the trouble and time equired for doubling Keweenaw point. The land is low and swampy or a considerable part of the way. The whole distance from the lake hore to the waters of Portage lake is a mile and a half.

August 10.—Messrs. Foster and Hill travelled along the shore a few miles south of this place, and found the strata of sandstone were nearly orizontal, and that no trap rocks occur near the shore.

August 11.—Messrs. Foster and Hill, accompanied by my boatmen, ent to the Quincy Mining Company's location, travelling part of the ay on a road, and then crossing a cedar swamp, the distance being ight miles. They obtained some good specimens of native copper, and eturned the next day. This mine I intend to visit when I enter Portage ake, on my excursion to L'Anse.

August 12.—This day I remained in camp on Porcupine river, awaiting he return of my assistant and surveyor.

August 13.—Returned to Eagle river, packed our specimens, and left hem to be sent to the Sault Ste. Marie by the propeller.

August 16.—We left Eagle river for Copper Harbor, stopping at Eagle Harbor to dine, and then rowed to Copper Harbor, where we arrived in he evening.

August 17.—I put a new tube into one of the barometers, which Mr. Barnes had injured on his journey to Torch lake; this work occupying ne two days.

August 18.—Took observations for longitude, and for rating the chro-nometer at Copper Harbor, and compared all our instruments preparatory o another excursion. The draughtsman, Mr. Schlatter, and Messrs. Foster and Hill, were engaged in drawing the sections we have measured, nd in coloring the map, so as to give the boundaries of the rocks we have examined.

August 19.—Sent Mr. Barnes to explore the country inland, and to fix ertain points of contact of the rocks, for the geological map, and to mea-ure some hills which I had not visited.

August 20.—Examined minerals I had collected, and ascertained the nature of those which were doubtful. Day rainy. Took no observations. Mr. Barnes returned, and had injured the barometer again. I repaired it immediately.

August 22.—We are still occupied with the map, which I am hastening to get ready to send to Washington.

August 23.—Took observations, and furnished data for the calculation of heights of places which are to be marked on the geological map. Mr. Thayer has been constantly employed in calculating my observations.

August 24.—This day I explored the whole circuit of Copper Harbor again, for the purpose of giving the boundaries of the rocks exactly on the map.

August 25.—Mr. Whitney and Dr. Gibbs returned from the Ontonagon river.

August 26.—Repaired Dr. Gibbs's barometer, which employed me this day and the next.

August 28.—The geological map is now ready to send to Washington, and was packed up carefully, and sent to the post office by Mr. Foster.

August 29.—Mr. Turrel, a friend of Mr. Foster's, took the map to put it into the mail at Mackinaw, the mail bag at Copper Harbor post office not being large enough to receive it.

August 30.—I sent Messrs. Foster and Hill, with a party of boatmen to explore the country from Keweenaw bay along the Menomonee river to Green bay, giving them minute instructions as to the observations they were to make, and especially concerning the determination of the positions of the sandstone rocks, and the extent of the iron ores which occur on that section, specimens of which I had obtained, through Mr. Barbeau, from the Indians in 1844, and which had been explored by Mr. Lyman Prey in 1845. They were instructed to make a sectional view of the rocks; determine their geological position and age, as accurately as practicable. (See copy of the instructions, annexed to Mr. Foster's report.)

Mr. Whitney's party, in company with Mr. Dickenson, who had just returned from Isle Royale, was sent to Iron river, and Mr. Whitney accompanied us to Keweenaw bay, from whence he was sent to examine a bed of limestone I had recently heard of as discovered by the linear surveyor, Charles F. Merian, who was at work for Mr. Higgins.

August 31.—Strong head winds delay us to-day.

September 1.—Wind still too strong for us to go round the point. Took observations this day preparatory to our voyage.

September 2.—Left Copper Harbor with two boats—one under the direction of Mr. Foster, and the other under my own. I am now about to complete the examination of the rocks at the head of Keweenaw bay, and to examine the mines on Portage and Torch lakes, and from thence to measure a section to Eagle river, exploring all the mines in the trap range running through the middle of Keweenaw point—this work completing the entire geology and mineralogy of the peninsula. We ran to the end of Keweenaw point, where we were overtaken by a thunder storm, and camped there for the night.

September 3, *Sunday*, 5 *a. m.*—We set out on our voyage, but were soon compelled to take shelter in the Boston and Lake Superior Company's cabins, on account of a violent rain storm. While we were de-

tained there, I made an examination of all the heaps of rubbish thrown out of the mines, and obtained a few specimens of veinstone containing a little copper. Near this place we examined a small dike of trap, which is largely impregnated with chlorite, and cuts through a brown trap rock. It was found to contain a little copper.

September 4.—Examined the position of this location, which is near the corner of the township lines, T. 58, R. 27, S. 31, as ascertained from the marks left by the linear surveyors. During our detention at this place by strong head winds, I ascertained its latitude to be north 47° 23′ 02″.

September 5.—Rowed against a strong head wind to Jasper point, where we were forced to land on account of the violence of the wind and swell of the lake. Observed at this place (near Jasper point) a dike of brown trap rock, cutting through the porphyritic variety, and thus proving the more recent origin of the brown trap, as I had previously ascertained at other places.

The wind abating, we set out again in the afternoon and ran round the curve of the bay to near the entrance of Lac la Belle, and then stood for Keweenaw bay, leaving the other boat to visit Lac la Belle, where Mr. Hill wished to go to obtain Mr. Schlatter's views on the Menomonee, which he had left at that place. In following the course of the lake near Lac la Belle, I examined the rocks very particularly at their points of junction. The gray sandstone is observed in large blocks suitable for building, though not very compact or strong. The strata in place dip southeast 20°. At the junction of this rock with the trap, and for half a mile north, the rock is brecciated, and a large castle-like outline projects into the lake, so that we could run behind it in our boat. The belt of trap in the rear of this breccia is only 40 feet wide. The reccia is seen near the landing of the Clinton Company. During a short stop at the Clinton Company's wharf, I took an observation for time, and then set out on our voyage again. A band of trap a quarter of a mile wide was seen between the breccia and gray sandstone. A curious crescentic band of white sandstone was seen in this bay, beneath the water, and about half a mile from the shore. After passing a band of trap we came again to red sandstone strata, dipping to the south 30°. Point Isabelle is a variegated sandstone cliff, consisting of alternate layers of red, gray, and mottled sandstone in nearly horizontal strata. Orbicular white spots, with nuclei of black, occur abundantly in the red sandstone, and appear to be concretions. Nodules and beds of red chalk are abundant in the gray sandstone, or between their strata. This cliff is very beautiful, the top being gray sandstone, the middle red, and the base striped alternately with gray and red. The cliff is perpendicular, affording no landing place: its height is 40 feet. The whole of this sandstone coast is abruptly precipitous, and it is dangerous for boats to be caught by high winds on such a lee-shore. The wind was in such a direction that I was enabled to sail quite near the rocks on the wind, so as to observe them leisurely as we ran along the coast.

September 7.—We reached Portage river, the outlet of Portage lake, took an observation for time, and then ran to Meneclier's, at L'Ance, where we chanced to meet Mr. Charles F. Merian, the linear surveyor, who discovered the limestone bed I was so desirous of examining. He kindly described the location of it, and offered to guide us to the spot.

This limestone is on township 51, range 35, at the corner of sections 13, 14, 23, and 24, near a branch of Sturgeon river. He says the limestone forms cliffs 300 feet high, exposing regular sheets 30 feet square. Mr. Whitney earnestly requested me to allow him to examine it, and he was permitted to do so, Mr. Barnes going with him to measure the height of the spot by barometric observation. Mr. Merian, the linear surveyor, guided them to the place. It was natural that some eagerness should be felt by my assistant to examine a spot which promised to settle the vexed question of the geological position and age of the sandstone of Keweenaw point. I gave this privilege to Mr. Whitney in preference to Mr. Foster because he had been disappointed in his hopes of going on the Menomonee section, which I had decided to give to Messrs. Foster and Hill. It has always been my custom to give to each assistant a particular section, and to allow him to report it himself, so as to test his ability, and to give him an opportunity of appearing in the report with work wholly his own. Therefore, I never feel disposed to interfere with any work which I have so consigned; and although I felt much curiosity to see this limestone ledge myself, I refrained from visiting it, and went to the head of the bay to examine other less interesting localities. Mr. Whitney sent back by Mr. Barnes some specimens of the limestone, which proved to contain a part of a *pentamerus oblongus*. I therefore sent Mr. McIntyre to request him to re-examine the rock for fossils, and to examine carefully its relations to the sandstone, for it was obvious, from what I had already seen, that the sandstone was horizontal; and if the limestone strata had a considerable dip, the sandstone would rest unconformably upon it, and thus be proved to be more recent than the limestone, which, from the fossils I had seen, was evidently an upper member of the silurian group, and probably the cliff limestone. This would prove that the sandstone of Keweenaw point was not the Potsdam or Caradoc, but either the old or the new red; and this locality gives evidence in favor of that opinion. That the sandstone is not the old red, would appear from the entire absence of fossil shells so common in that group. Now, the limestone before alluded to has, according to Mr. Whitney, strata marks dipping 30°, while the sandstone in the vicinity is in horizontal strata; and it is therefore evident, though no visible contact proves it, that the sandstone overlies the limestone, and is therefore more recent. It may be that this limestone underlies a large portion of Keweenaw point, and that the obscure fossil, resembling an orthocera, found in the breccia amygdaloid at Copper Falls mine, was torn from a bed of subjacent limestone, and brought up by the trap when it burst through the strata. It may be also that the abundance of calcareous spar in the amygdaloid, and the spar veins in the accompanying conglomerate rocks, can be accounted for by subjacent limestone. I regret that circumstances beyond my control prevented my assistant from completing his explorations, and that fearing he would fail to meet his party, which had been sent round the point, he hastily left the spot, so that some important data remain still to be obtained by a re-examination of the spot. The limestone is of a drab color, and is compact; an obscure or broken pentamerus is seen in one of the specimens. Its specific gravity is, by analysis, made in my laboratory by Mr. R. Cropley. It is composed of—

Carbonate of lime - - - - -	44.49
Carbonate of magnesia - - - -	44.65
Peroxide of iron - - - - -	1.98
Silica - - - - - -	8.91
	100.03

During the absence of Mr. Barnes, I examined Mr. Menedier's location, which is not mineral land, but is situated on sandstone strata. I gave him a certificate to that effect; he was wishing to purchase the place of government.

September 11.—I crossed over the bay to the Methodist mission, where Messrs. Foster and Hill had been stopping, and found that they had gone up the bay. Took a time observation at the new Methodist meeting-house. We were kindly entertained by Mr. Johnson, the missionary, and by Mr. Rathburn, the government blacksmith, resident at this place. They accompanied me in my explorations in the vicinity. The red sandstone strata on the east side of the bay dip to the northwest. A bed of hone-slate occurs a little farther up the bay, and consists of bluish drab-colored strata from half an inch to eight inches in thickness, which dip to the south-southwest 45°. The hone-slate divides into rhombic prisms, and it is easy to detach pieces suitable for whetstones. It is extensively employed for hones by the people on the lake, though it is rather too soft to sell advantageously in our market. A singular green trappean rock, tinged with chlorite, traverses this bed of hone-slate; quartz veins cut through it, near the dike, and some of them are three or four feet in width, and are pure milk-white quartz. In the hone-slate, iron pyrites occurs, and by its decomposition forms a sort of stalactitical hæmatite.

On the west of Keweenaw bay there is a deep, well-sheltered harbor, where a vessel may ride secure from every wind. Three miles north of this, on the east side, there is a good harbor, quite deep, with a bold shore, where vessels are secure from east, north, and west winds.

September 12.—An eclipse of the moon took place this night, beginning at 10h. 30′ p. m., and was total at 11h. 27′ p. m. The moon had a copper-red color during the eclipse. I lost the opportunity of making observations on it.

September 13.—Ran along the east shore of Keweenaw bay, and then made a traverse across the bay to Portage river, the distance across being 4 miles. The wind was very strong and nearly ahead, but by running down the coast we made out to lay our course across the bay, and just reached Portage river when the wind and sea were so violent that a boat could not have lived another hour outside. This storm, from barometric observations, we had foreseen, and were anxious to get into Portage lake before it came on; and we were most fortunate in effecting it. The rocks all along the coast to Portage river are mural precipices of red sandstone; no landing place existing for a great distance. In Portage lake we were safe, and could work when it was too strong to be on the Great lake. At Sheldon's, on Portage river, 3 p. m., B. 29.5, T. 16° C., t. 56° F. Storm rising fast; the lake is in a perfect fury, and breakers roll over the bar at Portage river, which is white with foam.

5¾ p. m., B. 29.420, T. 14° C., t. 56° F.

September 14.—8 a. m., B. 29.065, T. 11° C., t. 51° F. Heavy wind,

with rain, and wild driving clouds; wind, northeast. The barometer has fallen $\frac{8}{10}$ths of an inch since the 12th.

September 14.—11 a. m., B. 29 095, T. 11° C., t. 51° F.
12½ p. m., B. 29.110, T. 10¾° C., t. 51° F.
3 p. m., B. 29.200, T. 11° C., t. 51° F.
4 p. m., B. 29.210, T. 11½° C., t. 52° F.
6 p. m., B. 29.240, T. 10½° C., t. 51° F.

This evening the sky gives evidence of clearing, the sun appearing as it sets. The gale is still severe. During the violence of this storm the ducks were driven from the Great lake, and were very numerous in Portage lake. They came so near our cabin that we shot them from the door.

September 15.—7 a. m., B. 29.41; T. 7½° C.; t. 40½° F. The wind is now to the south, and the weather good. At 8 a. m. I took a time observation, and then set out on our voyage around Portage lake. Portage river is about 100 yards wide, and is bordered with tall rushes, and spruce and fir trees. The lake is a beautiful sheet of water, 18 miles in length and 5 miles in breadth, and communicates with Torch lake, which is a branch of it, by a narrow channel. We coasted along the shores of Portage lake, viewing the beautiful autumnal scenery, and examining every rock that was visible. The hills are covered with primeval forests of maple, ash, birch, pine, spruce, and fir trees. Pine trees are quite abundant; many of them are suitable for timber. The soil is generally good, especially on the trap rocks. The first mines which we came to were those formerly opened by the Pittsburg Company. We examined the location, and found all these cabins deserted, and some abandoned pits where search had been made for copper, but none was found. The rocks and soil are trappean, but the trap rocks are compact, and not metalliferous. About two acres of land have been cleared, and the soil now bears a fine crop of potatoes, which were planted by Mr. Sheldon, of Portage river. Three houses were built here by the company for the habitations of their explorers. At 2 p. m. we left this location, and ran to the westward. Passing along the coast, we came to the landing-place of the Quincy Mining Company. This is the only location on Portage lake now occupied, and but little has been done there in the way of regular mining, only two young men being employed there. The house belonging to this company is on a hill about half a mile from the landing-place. We were most hospitably received by Mr. R. C. Stiles and Mr. Lewis Isaac, the young men in charge of the location. At 3 p. m. I took a time observation near the house, and barometrical observations for the measurement of the height of the hill.

3½ p. m., B. 28.995; T. 19° C.; t. 61° F.
4½ p. m., B. 28.950; T. 16° C.; t. 60° F.
6*h*. 20*m*. p. m., B. 28.900; T. 11° C.; t. 52° F.

The height of this spot is 386 feet above Portage lake. Examined the mines and the geology of the location.

September 16.—8¼ a. m., B. 28.60; T. 18° C.; t. 55° F. Began to rain to-day. We learned from Mr. Stiles that this location was taken out in 1845, and a lease was obtained from the government in 1846. Seven men have been employed in sinking a shaft, and in clearing the land and exploring the location. The shaft was sunk by the labor of Stiles and Isaac. It is 67 feet deep and 4 feet square, and follows the slope of the vein. They found the vein to contain native copper and silver, samples

ich were given me. The vein runs N. 30° E., and dips to the N. /. from 50° to 55°. It is 1 foot wide, and is quite rich in metallic r. The rock in which this vein exists is amygdaloidal trap, con- g a veinstone of leonhardite, chlorite, and a green earthy mineral ıat of the Copper Falls silver vein. The copper at the surface was ted, and thickly encrusted with green carbonate and red oxide of r; but at a depth the metal was found to be bright metallic copper, occasional patches of silver in it. A small cross course comes into ein, and at the line of junction the vein expands and is much richer. reen veinstone, like that of Copper Falls, is found to be the princi- ngue of the silver. The amygdaloid resembles that of Eagle river. l be observed that the course of this vein is N. 30° E., while that at river is N. 30° W. It has rained so hard to-day that we cannot ıplish much work. At noon, at cabins, B. 28.57; T. 19° C.; t.

tember 17.—Examined the vein that has been opened near the . It runs N. 65° E., and dips NE. 55°. This vein is from 1 to 2 s wide, and contains sheets of copper, one of which weighed 40 lbs. t a hundred weight of copper is now in a tub in this trench, and no has yet been sunk on the vein.

tember 18.—Prepared to go up the lake this morning to make obser- ıs, but rain prevents. Measured a section from the mine to the lake. Barnes measured the distances, while I took the barometrical obser- ıs.—(See section, plate 5.)

tember 19.—9¼ a. m., B. 28.82; T. 18° C.; t. 49° F. Cloudy, so cannot make the observations I wish. We occupied ourselves at ıines.

tember 20.—7¼ a. m., B. 28.885; T. 16° C.; t. 47° F. This day :plored the lake quite to the portage. The line of junction of the tone and trap rocks was observed, and the dip of the strata taken. lip is N. 65° W. 25°. This was observed on the west arm of Port- ake. On the north arm of the lake the dip is NNW. 20° to 30°. ın to Torch lake, and from thence measured a section to Eagle river, ıg over the whole trappean range between Portage lake and that , and visiting all the mines on our way.

tember 21.—At Torch lake, 5 feet above the level of the lake, 7¼ a. . 29.615; T. 90° C.; t. 41° F.

rch lake, 9¼ a. m., B. 29.662; T. 9° C.; t. 47° F.

uglass Houghton Falls, 10h. 25m. a m., B. 29.411; T. 9° C.; t.

p of the falls, 11¼ a. m., B. 29.282; T. 8¼° C.; t. 45° F.

ight of the falls 115 feet.

amined the Douglass Houghton Company's mines near the falls. ft 40 feet in length has been excavated near the foot of the falls. A irregular vein, from 1 to 3 inches wide, containing minute scales of :r, was found, but it is of no value. The veinstone is silicate of Another drift has been made in the rocks lower down the stream, penetrates into the ledge 33 feet, but does not expose any metalliferous vein. Thirty or forty feet farther down the stream we noticed a slaty rock with decomposed trap rock, glazed with chlorite. In a vein of leonhardite and laumonite, 8 or 9 inches wide, which o the NW. It does not contain copper. Having collected speci-

mens of the veinstone containing a little copper from the upper drift, and of the different rocks and minerals of this place, and measured the height and slope of the falls, we set out for the Michigan Company's location. At 12h. 20m. we crossed a stream 1 rod wide; at 12h. 40m. we crossed another stream 1 yard wide; at 1h. 10m. p. m. we crossed a third stream 4 feet wide; and 1h. 15m. p. m. we came to the base of the hill on which the Michigan Company's houses are built, and where their abandoned mines exist. At 5 feet above the level of the stream, B. 29.58; T. 10° C.; t. 46° F.

Michigan Company's cabins, 1h. 50m. p. m., B. 29.175; T. 10½° C.; t. 46½° F.

Examined the mines, which are excavated in trap rocks. Drift penetrates the rock in a direction S. 25° W. 30 feet. A few spots of green carbonate of copper on the ledge seems to have induced the miners to make this excavation. The discovery of a few irregular veins of leonhardite, containing a little native copper, were the only results of this exploration. Near this mine the conglomerate rock was seen dipping to the northwestward; sandstone strata, colored blue by a film of iron ore, were also observed. The trap rock where the drift enters it is decomposed, and is colored by the formation of green carbonate of copper. A stream runs directly by the mouth of the drift, crossing the rocks in an east and west direction, and thus exposing them in its bed to a considerable extent. No vein of any value exists at this place. At the cabins at 3h. 10m. p. m., B. 29.16; T. 8° C.; t. 46° F.

Travelling towards the Trap Rock Company's cabins, we took an observation on the first hill, one mile from Michigan Company's cabins, where the barometer stood, at 3h. 40m. p. m., B. 29.04, T. 9° C., t. 44° F. At Trap Rock Company's location, at 4h. 12m. p. m., B. 29.048, T. 9½° C., t. 44° F. Examined the mines belonging to this company: they have excavated a drift and sunk a shaft on a narrow vein of prehnite, included in compact trap rock, but were unsuccessful in their operations, and have abandoned the location. The shaft was full of water, so that the nature of the matters in the mine could only be judged by the examination of the rubbish around it. The soil on this location is excellent, and the timber is large and sound—the growth being a mixture of the usual hard-wood trees with scattered pines. The company had erected a very good and substantial house of square timber, and had cleared a considerable tract of land, and cultivated it to some extent. A stream of good water runs near the house, and falls about five feet near the mines. This location, although not valuable for mining, will afford a very good farm to some future settler. After a rapid examination of this location, we continued our march to the Forsyth Company's location. Descending first a steep hill to Trap Rock river, we made barometrical observation one mile NE. from the Trap Rock Company's cabins; and four feet above the level of the stream, 4h. 45m. p. m., B. 29.501, T. 9° C., t. 43° F. We observed the forest trees to be unusually large, and the growth open, on this location; and along the trap ridge we have been walking over, large pine trees occur scattered among maple, birch, black oak, and ash trees—the hard wood generally predominating. This indicates a good soil; and the few garden patches which have been cultivated near the miners' cabins sustain this opinion. (See analysis of this soil.) Crossing over a gentle rise of land, we descended rapidly to the Forsyth Company's cabins, where we stopped to make observations, and to

xamine the mines, which are at present abandoned for want of pecuiary means, the company having done but little towards opening the ein, which has given proofs of richness. At Forsyth Company's cabins, ¾ p. m., B. 29.298, T. 8½° C., t. 39° F. We stopped at this place for ne night, and then spent some time the next day in exploring the mines nd measured a section.

September 22.—At cabins, 7h. 20m. a. m., B. 29.331, T. 3½° C., t. 9° F.

Upper shaft of the mine, 8h. 15m. a. m., B. 29.250, T. 8½° C., t. 8° F.

Second shaft, B. 29.301, T. 10° C., t. 48½° F.

Third shaft, B. 29.340, T. 11° C., t. 49° F.

Swamp lowest drainage, B. 29.398, T. 11¼° C., t. 49° F.

While I was making the measurement of heights of these points, Mr. Barnes, assisted by Mr. Stiles, measured the distances, which furnished he ground plan for the accompanying section. (See plate 6.) The folowing minerals were found by me during this examination of the Forth mines: epidote, calc spar, laumonite, leonhardite, and native copper nd silver. These minerals in the aggregate form the lode of the vein; nd the width of the whole varies from one to two feet. Large pieces of opper, with silver adhering, were abundant in the vein; and numerous ieces of those metals have been taken from the ore-heap by visiters. From the richness of this vein at the surface, its width and convenient ituation for mining, I should recommend a thorough exploration of it by ystematic mining, by one or two deep shafts and levels, properly arranged for stopeing out the metal. It is obvious that the shallow pits ow sunk on the vein show only its surface, and that they can only be egarded, like most of those we have seen at other locations, as mere uperficial explorations, or "*prospecting diggings*," as they are called in he west.

Thus far on our march from Torch lake, we have not seen any other uman being than our own party, all the locations on this route having een abandoned. Some one has visited several of the best cleared tracts f land and planted potatoes, which are now ripe, and are uncommonly ood—no potatoe disease having yet reached this district. The crop will robably be consumed by the miners on Eagle river, for whom it was robably raised.

September 23.—Two miles south of the Albion Company's mines, at he brook, B. 29.27, T. 13° C., t. 53° F.

At Medora furnace, 10¾ p. m., B. 29.30, T. 14° C., t. 51° F.

We stopped to examine the furnace, which proved to be worthless, nd is now in ruins.

At the house in the North American Company's location, 12h. 25m. . m., B. 29.287, T. 15½° C., t. 56° F.

At the office, 1h. 7m. p. m., B. 29.250, T. 13° C., t. 56° F.

At top of shaft, 1h. 30m. p. m., B. 29.200, T. 14° C., t. 59° F.

Having dined at this place, we were politely accompanied by Messrs. Coxe and Borden, the mining captains who have charge of the work, in ur examination of the mines; and every opportunity was afforded me for thorough exploration of the vein wherever it had been exposed by ining. This mine has been on a trial for some time without adequate ecuniary means for regular mining to a suitable depth; but, through the

persevering efforts of John Bacon, esq., the superintendent, the mine was proved to be worthy of a greater outlay in working, and it is now in a prosperous condition. It is favorably situated in all respects, and is very similar to the Boston and Pittsburg Company's Cliff mine, which has already been so well proved; but the vein was not exposed in the face of the cliff, like theirs, so that it could only be discovered by mining. This has been effectually done, and all the works are substantially built, so that few changes will be required in future operations. An excellent horse-whim, well constructed, stands near the shaft, and is adequate to raise all the water and metals from the mine. The main shaft penetrates 155 feet; on and by the side of the vein, and from it, several properly constructed levels are sent off. The vein was found to become more vertical as it extended downwards; and now, at the bottom *winze*, it has a dip of 79°, while, in the upper part of the vein it dipped only 60°. The mining operations are more easy as the vein approaches a vertical position; for the shafts must be made perpendicularly through the rock for convenient working of a mine. From the main shaft, at the depth of ninety feet, the miners have sent off a level in a SE. by S. direction, and have exposed a considerable portion of the vein. It was found in some places to narrow to eight inches, and in others to expand to fifteen inches in width; but its general average is about one foot. In the lowest part of the mine, in the *winze*, which has been sunk from one of the cross-cuts, the vein was found to be very rich in copper—solid masses of it being extracted from the vein. After traversing every level and cross-cut, and descending the inclined plane to the bottom of the *winze*, noting the appearance of the vein in every place where it was exposed, and collecting specimens, I took the temperature of the water in different parts of the mine.

At 123 feet from the surface, the water had a temperature of 45° F.

At 95 feet from the surface, a spring was found having a temperature of 43° F.

At 155 feet from the surface, the water of the mine was 44° F.

The temperature of the external air was 59° F.

From these observations and those I had made at different seasons of the year, it will appear that the mines, which have penetrated to the depth of one hundred feet, have a uniform temperature of 44° F., and that the temperature is not affected by the heat of summer, though it is probable that in winter the cold air may penetrate into the mines and affect the temperature of the air. The mean annual temperature of the climate is $42\frac{1}{10}$° F., according to observations at Fort Wilkins. From the best observations that could be made in the North American Company's mine, the vein has a course of N. 50° W., S. 50° E., and a dip increasing from 59° to 79° to the northeastward. Fourteen miners and eleven laborers are employed at this mine at present. The miners' pay is from twenty-five to twenty-eight dollars per month, and that of the laborers is sixteen dollars per month. It will be necessary to increase the number of miners, in order to prosecute mining steadily. A stamping mill, with suitable washing apparatus, is also to be erected for freeing the poor ore from rock. From a trial made of this stamp ore at the Boston and Pittsburg works, it gives from five to six per cent. of metals—the metals being large grains of copper mixed with smaller grains of silver.

n leaving the mine, I observed the barometer which I had left hang- at the mouth of the main shaft, and found, at 3h. 55m., it stood 29.20, T. 18° C., t. 55° F. After collecting specimens of all the mine- found at this mine, and receiving a handsome sheet of copper as a sent from Mr. Coxe, the grand mining captain, we went to the Boston Pittsburg Company's mines, which are quite near to this place, and nd the barometer, at 5h. 35m., stood B. 29.150, T. 12° C., t. 46° F. We then examined the stamping mill and working apparatus, and saw washers clean the metal from the rock. The earthy matter is nearly separated by the *strake* and by *jigging*, and the metals contain but ten cent. of earthy matter when packed in casks for transportation to mar- . The clerk informed me that he had sent this year 806 tons of cop- to market, and had 60 tons now ready to forward by the next vessel. ey expect to send from 900 to 1,000 tons of copper to market per an- n. They estimate the metal sent as containing 65 per cent. of pure per; but it is probably much richer, since most of it is in solid blocks of per, with but little rock adhering to its surface. The largest mass of per thus far separated from the vein weighed 80 tons! This was cut into pieces weighing from one to two tons. In company with Captain ward Jennings, who has charge of all the mining operations, I de- nded into the mine, and took notes of every fact of interest. I also sured the temperature of the water in all parts of the mine, and ob- ied the following results:

t 60 feet depth from the surface, the temperature of the water was 44° F.
t 120 feet depth from the surface, the temperature of the water was 44° F.
t 180 feet depth from the surface, the temperature of the water was 43° F.
t 236 feet depth from the surface, the temperature of the water was 45° F.

rom these observations it will appear that this mine has already hed a sufficient depth to be affected by the heat of the earth's interior. we regard 43° as the mean temperature of the climate, we shall have ise of temperature of one degree Fahrenheit for 88 feet in depth. ien the mines have attained a greater depth, we may have an opportu- y of testing this question more satisfactorily. It is obvious that these nes are the best places for investigating this subject; for there being no ites or sulphurets, or any mineral decomposing capable of producing it thereby, we are free from the objection made to some of the Euro- n experiments on the increase of temperature in mines. The depth of s mine from the surface of the ground at the shaft is 236 feet, but the f above it is between 200 and 300 feet high; and by running a level m the bottom of the shaft and under the cliff to a considerable distance, s probable that a more sensible increase of heat will be found at the tom. The temperature 43° F. was obtained in the farther end of the el, which goes off from the shaft at 180 feet from the top of it towards south, (the distance being 20 fathoms,) and by slope of the land the el must be much nearer the surface than at the shaft; hence a fall of perature. The point where that observation was taken is 20 feet th of the office, where the perpendicular depth cannot be more than) feet to the end of the level. The highest temperature was obtained in sump of the engine shaft. The observations which gave 44° F. were en 2 feet below shaft 3, and in the adit level 60 feet from the surface. s highly probable that, when the deepest level shall penetrate beneath cliff, the temperature of the water will be at least as high as 47° F.

At present the deep level has not been extended in that direction far enough to test this question. The plane of invariable temperature appears to be lower than is usually supposed. The lowest level runs 30 fathoms south and 30 fathoms north from shaft No. 1. All the vein for two feet in width contains copper, and will furnish what Mr. Jennings calls "*barrel* and *stamp work*." The barrel ore contains from 30 to 50 per cent. of copper, and the stamp work varies from 5 to 10 per cent. of a mixture of copper and silver. The 300 feet level does not yield so rich ore. At present the miners are stopeing out the backs of levels, and strong scaffoldings of heavy timber are placed across the opening to receive the rock and metal. These the miners call *stalls*. The miners were at work cutting up a large mass of copper which had been blown down from the walls of the vein by heavy blasts of gunpowder. This mass weighs ten tons, and is the remainder of the great mass which was estimated to weigh 83 tons. Eight men are now employed in cutting it up with chisels. They informed me that they cut up a mass last winter weighing 50 tons. It was of an irregular form, and was 36 feet long, 12 broad, and about 18 inches thick in the middle. No one who has not seen these mines can have any idea of the ready manner in which these great masses of copper are cut up and removed by the miners. So soon as the copper is cut up into masses that can be removed by iron bars, it is slid down into the level, and there, by means of stout iron chains and pulleys, aided by an occasional lift with iron bars when it becomes entangled, it is rapidly moved along the level to the shaft, where the horse-whim, which has drawn it along the gallery, raises it to the surface, and it is sent down on a chariot which runs upon a tram-road to the platform, where it can readily be put into the wagon which is driven to receive it therefrom. By means of a windlass and crane, each piece is elevated and weighed, and its weight is stamped upon it before it is sent to the shore for shipment. The present price of cutting up the copper is $7 per square foot of cut surface, one side being measured. The work is let out on contract to the miners. One man holds the chisel while the other strikes with the sledge, as described in my report for last year. One hundred and fifty men are employed at this mine, seventy-five of whom are practical miners, and mostly from mines in Cornwall. A few specimens were added to our collection from this mine during this visit, which was to be the last for the season. I requested the clerk and agent to send me a statistical report of the working of the mine, which they promised to have prepared for me, but it has not yet been received.

Leaving this mine, we went to the mouth of Eagle river, where the barometer at 15 feet above the lake stood, at 4h. 26m. p. m., B. 29.417, T. 13° C., t. 51° F. This completed our examination of the whole trap range and the various mines along its course and on its borders. The excursion was quite interesting although fatiguing, since it was necessary to work very hard in order to complete it in season, and while our provisions lasted.

The boat was sent from Portage lake to Copper Harbor under the charge of Mr. Thayer, who carried with him my sextant and chronometer, and such things as we could not transport on our journey through the woods.

September 25.—Remained at Eagle river. Settled with Stiles and Isaac for their assistance, and sent for our boat to meet us at Eagle Harbor.

September 26.—We made a visit to Copper Falls mines, on our way to Eagle Harbor. Measured again the height of that place:

Five feet above the level of Lake Superior, at Sand Bay, B. 29.61, T. 10° C., t. 48° F.

At the office of the Copper Falls Company, B. 29.31, T. 12° C., t. 50° F.

During this visit I reviewed all the works, and was assisted most kindly by Mr. Childs, the superintendent. At the place where Mr. Seymour had proposed to drive an adit into the mine, the rocks are fine red sandstone, which dip to the NW. by W. 27°. The adit proposed was 7 feet high, 5 feet wide, and has been excavated 60 feet in length. Its course was to be S. 25° E. It was supposed by him that it would be on the vein, but Mr. Childs soon proved that such was not the case. It would drain the mine to nearly the depth of 200 feet, and was estimated to cost $10,000. It was decided by the company not to make this adit until the mine had been more fully proved. I collected during this visit all the species of minerals found at this mine, examining all the heaps of ore and rubbish from the mines. The following are the species and varieties found:

Red and white analcime; laumonite; leonhardite, red and green; red felspar, a peculiar variety; a curious prismatic analcime, since proved to be a mixed mineral; apophyllite, fine crystals; mesotype; datholite; crystals of calc spar; crystals of copper and native silver. Mr. Childs also presented me with a few rare crystals for examination, and some better specimens of copper than we could find in the ore heaps. He most cheerfully furnished me with all the statistics of the mine I desired, and proposed to send me a plan he had drawn of the whole underground work. This he has since done, and a copy of his plan by Mr. R. Cropley is given in plate 14.

The following measurements were furnished by Mr. Childs:

Depth of shafts.—A, 47 feet; B, 130 feet; C, 43 feet; D, (winze below adit level,) 66½ feet.

Length of levels.—Main adit, 482 feet, including cross-cut to lode; P W, 28 feet from A to B; F G, 71 feet from junction (T) of sandstone and trap to shaft B; H F, 131½ feet from B to C; L H, 130 feet from C to E; H T, 89$\frac{11}{12}$ feet; sandstone V. contains copper for 6 or 8 feet.

Lower level in shaft B, 120 feet.

27 feet north, 2d level south, in shaft B, 55 feet—adit running 57 feet south.

Level below winze D and shaft E, 64 feet.

Thirty three men are employed at these mines, twenty of whom are regular miners and thirteen laborers. The amount of ore raised and shipped is 94,994 pounds, which averaged 70 per cent. of metal. One mass of pure copper raised from this mine weighed 14,000 pounds. It was cut up by means of a cross-cut saw worked by two men, and cost $7 per square foot of cut surface to divide it into masses that could be transported to Eagle Harbor in the wagon. Three other masses have been got out which weighed from 7,000 to 8,000 pounds each. In a shaft 6 feet by 8 feet four miners will excavate 16 feet per month in depth, two shifts of men being employed. In working the mine at the lower shaft, 12 hours out of the 24 are employed in raising water from the mine. The first mass of copper which was obtained at this mine was then the largest that had been seen in the world. It was extracted from the vein about 50 feet from the surface. This mass weighed 8 tons.

Between C and B a mass of copper was obtained which weighed 7,018 lbs.
Between A and B do do 7,484 "
Between C and E do do 7,678 "
The 8 tons mass, when cleaned, weighed - - 14,000 "

These four large masses of copper were all sent to Boston and sold to the manufacturers. Besides the masses a large amount of barrel and stamp ore is raised, the per centage of which has not yet been determined by the proper operations. The course of the vein is S. 25° E. Its dip is to the SW. 85°, as observed in 2d level from shaft B going south. I observed a feeder on the SW. side of the lode. In the winze 55 feet below the level I found the dip of the vein to be SW. 73°. Its course was S. 25° W., as above given. The vein here is 3 feet wide, and is full of copper. The general slope of the winze is 70°. I measured the temperature of the air and water in this mine, and found—

At 20 feet from the surface the temperature of the water of the mine was 44½° F.

At 120 feet from the surface the temperature of the water of the mine was 44½° F.

The temperature of the air of the mine was 49° F.

The temperature of the air above ground was 42° F.

These observations, compared with those I had previously taken, show a uniform temperature, not far from the mean temperature of the climate and that of the great lake, exists in this mine.

By measurement of the outcrop of the sandstone which underlies the perpendicular shafts made in this mine, the thickness of the sandstone beneath was estimated at 75 feet. By actual perforation of it under the direction of Mr. Childs, the thickness was proved to be 72 feet. The accompanying diagram will explain the position of the trap and sandstone in this mine.

Before leaving for Eagle Harbor, the barometer was observed at Copper Falls.

At Copper Falls, at noon, B. 29.145; T. 6° C.
2¼ p. m., B. 29.182; T. 5½° C.
4 p. m., B. 29.162; T. 5° C.

We then walked to Eagle Harbor, where—

At 5 p. m., B. 29.410; T. 4° C., t. 36° F.
7¾ p. m., B. 29.380; T. 1½° C., t. 33½ F.

We saw Mr. Nichol Stautenburg, agent of the Northwest Company's mine, who promised to send me a statistical account of the mines under his management, in the course of the winter, but I have not received his report.

Dr. Gibbs arrived at Eagle Harbor, and we took passage in his boat to Copper Harbor, meeting my boat at Agate Harbor, where she had been detained by head winds.

September 28.—We removed our articles from Fort Wilkins to Mr. Brockway's house, and left the articles we should require next season, at his store. Our boat was put into the store at the fort, and we are now prepared to return home, having accomplished all the work we can do this season.

September 29.—We await the arrival of the propeller, which is to make her last voyage to the Sault Ste. Marie for this season.

September 30.—We left Copper Harbor, in the propeller, for the Sault Ste. Marie. On our way across the lake, I took the temperature of the

water of the lake in latitude 47° 20′ 30″ north, longitude 86° west. The temperature of the air at 8 a. m. being 44° Fahrenheit, that of the water was 43° F. Comparing this with previous observations, it will be found that the lake has a nearly invariable temperature, which is that of the mean temperature of the climate of that place.

October 1. —We have been beating against a head wind since we set out on our voyage. When in the middle of Lake Superior, I took four bottles of water of the lake for analysis, the results of which are given in this report.

October 2.—This day we reached the Sault Ste. Marie, and remained there until the 6th, when we left for Mackinaw in the steamer "Detroit." At Mackinaw we met with Messrs. Foster and Hill, who had just arrived from Green Bay, and were on their way home. When the steamboat "Superior" arrived we took passage from Mackinaw to Detroit, and reached that place on the 9th. Called on the surveyor general to request township plats of Isle Royale, and such other township plats as had not been sent to me. Left for Buffalo, where we arrived on the 10th, and at Boston on the 13th.

My assistants went home by various routes—some by Canada; others through Ohio, &c.; so that it was some time before they all arrived and were ready to prepare their synopses, to accompany mine. I requested them to send in, as soon as possible, their reports. Mr. Foster sent me a letter, as requested, from Green Bay, and Mr. Whitney sent in his synopsis, both of which were communicated by me, with a short account of the survey for the season, as required by my instructions. Thus ended the survey for the season. All was accomplished that was required, excepting the further exploration of the iron ore district, between the Lakes Michigan and Superior, and an examination of the mines on the Ontonagon river, which I proposed to visit myself the next season, in order to include an account of them in my report on the copper mines. I proposed to send to the iron ore district a scientific and *practical furnace-master*, who was prepared to give a judicious opinion as to the practicability and economy of manufacturing iron in that region, and to visit myself every locality of economical importance before closing the survey.

I requested the honorable Secretary of the Treasury to ask for a small additional appropriation, which, added to the balance unexpended, would have enabled me to complete the work in a manner satisfactory to the public and to myself. I had asked for an appropriation of $6,000, and Congress liberally granted $8,000; so that we should have had more than enough to have carried my survey to completion.

It is well known that my plans were frustrated, in a manner little expected by me, and my work is left incomplete from no fault of mine. I have done all I could with the few materials left in my hands, and herewith present my own personal observations; and the reports sent in by my late assistants, J. W. Foster and J. D. Whitney, jr., are appended, without any alterations or corrections. Their relations to me will serve to explain some of their *representations*, on which I shall forbear to comment.

Remarks on mines of native copper.

Mines of native copper are quite rare. The only ones of any extent, excepting those on Lake Superior, are in the Ural mountains, in Russia, and there the masses are of moderate size.

Small pieces, resulting generally from the decomposition of sulphurets, are found in the mines of Cornwall, and near the surface in the copper mines of Cuba.

In the trap rocks of America, we find native copper in Nova Scotia, Connecticut, and New Jersey; and within the arctic regions of this continent, large masses are found on the Coppermine river. Sir John Richardson says that large masses of native copper were carried from Copper mine river to England thirty years ago, and that masses of the pure metal are frequently met with in that extensive trap range.

No place in the world has thus far produced such astonishingly large masses as the country on the south side of Lake Superior, where the metal exists in regular veins, from which large elipsoidal masses of pure copper, weighing more than eighty tons, have been excavated. It was generally supposed that these veins would run out, as they were wrought to a considerable depth, but thus far no signs of their exhaustion have been seen: on the contrary, the quantity of metal in the lodes steadily augments, and the thickness of the masses increases.

I shall now describe the method of extracting the copper by mining operations. When by shafts and levels the mine is properly opened, the operation of *stopeing*, or working by grades, commences in the lower levels, and a wall of copper is laid bare on one side by blasting away the veinstone and rock. After a mass is thus uncovered, it is followed to some place where its continuity is broken, and there an excavation is made behind it, and the mass is cleared as much as possible all around its edges. Then a heavy blast of gunpowder, frequently amounting to a *hundred pounds*, is placed behind, and tamped with sand, and fired by a long fuse, the miners all ascending from the mine at the time. The blast being fired, the copper is torn from the walls and thrown down upon the "*stolls*," or scaffolding, and is there cut up into pieces that can be readily moved by the chains from the horse-whim. Then the masses are raised from the mine, and removed on a tram-road to the depot. The smaller masses, which are most frequently raised—not requiring to be cut up—along with the rock and veinstone filled with copper, are sent up in "*kibbles*," or tubs, raised by the horse-whim. This is the common method pursued in the native copper mines. From the Cliff mine on Eagle river, about 860 or 900 tons of copper, averaging 65 per cent. of pure metal, is raised per annum; and much of it is quite pure copper, requiring only fusion to cast it into the forms required for the manufacturer.

Method of mining for native copper.

The usual processes of mining are generally pursued in opening the veins of native copper; but the peculiar character of the lodes causes some variation in the miner's operations. Many of the ideas brought from the mines of Cornwall are found to be inapplicable to this novel kind of mining; and those guides which are considered reliable in Europe are here found unavailing. Instead of great masses of "*gossan*" and "*fluckan*," the miner here finds at the surface a clean, well-defined vein of prehnite, containing fine scales and small particles of native copper. Mindic, or iron pyrites, does not mingle with the contents of the vein; and the minerals accompanying the copper are entirely different from those of European mines. Instead of oxide of tin, mixed with a lode of copper

pyrites, the miner finds here pure silver, imbedded in solid copper, or mixed with the veinstone. Minerals which he does not know the name of are continually meeting his eye, and he feels that he is in a new "*country*," where the rocks are not killas and granite, with porphyry-elvans, but trap rocks and sandstone, exhibiting all their various admixtures and alterations, effected by fire. Beginning with a series of new minerals, he learns from mineralogists who visit the mines their names and characters, and as it were begins the study of mineralogy while exploring for mines. The superintendents, properly instructed as to the nature of the minerals, call them by their scientific names, and the antiquated jargon of the Cornish miners gives way to the language of science. This will be remarked by every mineralogist and geologist who visits the mines of Lake Superior; and I will venture to affirm that nowhere will he find the miners better acquainted with the true names of the minerals of the country.

Mode of opening a mine.

After making superficial explorations determining the course and dip of the vein and the contour of the ground, the miner makes the arrangements for extracting the ore or metal. If his ground permits his first working to be in the side of a hill or cliff, he opens a drift or level into the hill side and penetrates the vein along its course, excavating a gallery 4 or 5 feet wide and 6 feet in height. Near the opening or mouth of his gallery the materials are generally loose, and require supports of timber; but, on penetrating into the solid rocks, he finds them sufficiently firm to sustain themselves, so that no timbering is required. The framework supporting the loose materials at the opening of the drift is made of strong timber, as represented in the annexed drawing; which requires no further description. When a gallery is of considerable extent it is proper to lay a train or narrow railway for the transportation of the ore and rocks, by means of a chariot; but in temporary works a plank laid in the bottom of the gallery makes a sufficiently good road for the wheelbarrow, which is generally used in such excavations.

A similar method is pursued in the construction of an adit level, for draining the water from a mine. It is necessary that this gallery should have a gentle slope, just sufficient to enable the water to run from it; and it is customary in wet mines to sink a shallow channel in the bottom of the gallery for draining off the water, and to cover this channel by a plank. In excavating the gallery, as in other mining in hard rocks, gunpowder is used for shattering the rocks, and much skill and experience is required to produce the most efficient blasts. The holes for blasting are all made by means of steel drills, held by the hand, and driven with a hammer and sledge, churn drills, such as are used by quarrymen, being never employed by miners, they being only suitable for drilling perpendicular holes on the surface, while the miner has to drill in every direction, and generally at an angle considerably inclined from verticality. When the rock has been shattered by the blast, it is broken up by means of the sledge, and is transported in wheelbarrows or in chariots from the gallery, and the ore or metal is picked out from the rubbish and placed in a separate heap. The first drifts made on the vein are to be regarded as preliminary researches in most cases, for it seldom is advisable to open a

At present the deep level has not been extended in that direction far enough to test this question. The plane of invariable temperature appears to be lower than is usually supposed. The lowest level runs 30 fathoms south and 30 fathoms north from shaft No. 1. All the vein for two feet in width contains copper, and will furnish what Mr. Jennings calls "*barrel* and *stamp work*." The barrel ore contains from 30 to 50 per cent. of copper, and the stamp work varies from 5 to 10 per cent. of a mixture of copper and silver. The 300 feet level does not yield so rich ore. At present the miners are stopeing out the backs of levels, and strong scaffoldings of heavy timber are placed across the opening to receive the rock and metal. These the miners call *stalls*. The miners were at work cutting up a large mass of copper which had been blown down from the walls of the vein by heavy blasts of gunpowder. This mass weighs ten tons, and is the remainder of the great mass which was estimated to weigh 83 tons. Eight men are now employed in cutting it up with chisels. They informed me that they cut up a mass last winter weighing 50 tons. It was of an irregular form, and was 36 feet long, 12 broad, and about 18 inches thick in the middle. No one who has not seen these mines can have any idea of the ready manner in which these great masses of copper are cut up and removed by the miners. So soon as the copper is cut up into masses that can be removed by iron bars, it is slid down into the level, and there, by means of stout iron chains and pulleys, aided by an occasional lift with iron bars when it becomes entangled, it is rapidly moved along the level to the shaft, where the horse-whim, which has drawn it along the gallery, raises it to the surface, and it is sent down on a chariot which runs upon a tram-road to the platform, where it can readily be put into the wagon which is driven to receive it therefrom. By means of a windlass and crane, each piece is elevated and weighed, and its weight is stamped upon it before it is sent to the shore for shipment. The present price of cutting up the copper is $7 per square foot of cut surface, one side being measured. The work is let out on contract to the miners. One man holds the chisel while the other strikes with the sledge, as described in my report for last year. One hundred and fifty men are employed at this mine, seventy-five of whom are practical miners, and mostly from mines in Cornwall. A few specimens were added to our collection from this mine during this visit, which was to be the last for the season. I requested the clerk and agent to send me a statistical report of the working of the mine, which they promised to have prepared for me, but it has not yet been received.

Leaving this mine, we went to the mouth of Eagle river, where the barometer at 15 feet above the lake stood, at 4h. 26m. p. m., B. 29.417, T. 13° C., t. 51° F. This completed our examination of the whole trap range and the various mines along its course and on its borders. The excursion was quite interesting although fatiguing, since it was necessary to work very hard in order to complete it in season, and while our provisions lasted.

The boat was sent from Portage lake to Copper Harbor under the charge of Mr. Thayer, who carried with him my sextant and chronometer, and such things as we could not transport on our journey through the woods.

September 25.—Remained at Eagle river. Settled with Stiles and Isaac for their assistance, and sent for our boat to meet us at Eagle Harbor.

September 26.—We made a visit to Copper Falls mines, on our way to Eagle Harbor. Measured again the height of that place:

Five feet above the level of Lake Superior, at Sand Bay, B. 29.61, T. 10° C., t. 48° F.

At the office of the Copper Falls Company, B. 29.31, T. 12° C., t. 50° F.

During this visit I reviewed all the works, and was assisted most kindly by Mr. Childs, the superintendent. At the place where Mr. Seymour had proposed to drive an adit into the mine, the rocks are fine red sandstone, which dip to the NW. by W. 27°. The adit proposed was 7 feet high, 5 feet wide, and has been excavated 60 feet in length. Its course was to be S. 25° E. It was supposed by him that it would be on the vein, but Mr. Childs soon proved that such was not the case. It would drain the mine to nearly the depth of 200 feet, and was estimated to cost $10,000. It was decided by the company not to make this adit until the mine had been more fully proved. I collected during this visit all the species of minerals found at this mine, examining all the heaps of ore and rubbish from the mines. The following are the species and varieties found:

Red and white analcime; laumonite; leonhardite, red and green; red felspar, a peculiar variety; a curious prismatic analcime, since proved to be a mixed mineral; apophyllite, fine crystals; mesotype; datholite; crystals of calc spar; crystals of copper and native silver. Mr. Childs also presented me with a few rare crystals for examination, and some better specimens of copper than we could find in the ore heaps. He most cheerfully furnished me with all the statistics of the mine I desired, and proposed to send me a plan he had drawn of the whole underground work. This he has since done, and a copy of his plan by Mr. R. Cropley is given in plate 14.

The following measurements were furnished by Mr. Childs:

Depth of shafts.—A, 47 feet; B, 130 feet; C, 43 feet; D, (winze below adit level,) 66½ feet.

Length of levels.—Main adit, 482 feet, including cross-cut to lode; P W, 28 feet from A to B; F G, 71 feet from junction (T) of sandstone and trap to shaft B; H F, 131½ feet from B to C; L H, 130 feet from C to E; H T, 89$\frac{9}{12}$ feet; sandstone V. contains copper for 6 or 8 feet.

Lower level in shaft B, 120 feet.

27 feet north, 2d level south, in shaft B, 55 feet—adit running 57 feet south.

Level below winze D and shaft E, 64 feet.

Thirty three men are employed at these mines, twenty of whom are regular miners and thirteen laborers. The amount of ore raised and shipped is 94,994 pounds, which averaged 70 per cent. of metal. One mass of pure copper raised from this mine weighed 14,000 pounds. It was cut up by means of a cross-cut saw worked by two men, and cost $7 per square foot of cut surface to divide it into masses that could be transported to Eagle Harbor in the wagon. Three other masses have been got out which weighed from 7,000 to 8,000 pounds each. In a shaft 6 feet by 8 feet four miners will excavate 16 feet per month in depth, two shifts of men being employed. In working the mine at the lower shaft, 12 hours out of the 24 are employed in raising water from the mine. The first mass of copper which was obtained at this mine was then the largest that had been seen in the world. It was extracted from the vein about 50 feet from the surface. This mass weighed 8 tons.

Between C and B a mass of copper was obtained which weighed 7,018 lbs.
Between A and B do do 7,484 "
Between C and E do do 7,678 "
The 8 tons mass, when cleaned, weighed - - 14,000 "

These four large masses of copper were all sent to Boston and sold to the manufacturers. Besides the masses a large amount of barrel and stamp ore is raised, the per centage of which has not yet been determined by the proper operations. The course of the vein is S. 25° E. Its dip is to the SW. 85°, as observed in 2d level from shaft B going south. I observed a feeder on the SW. side of the lode. In the winze 55 feet below the level I found the dip of the vein to be SW. 73°. Its course was N. 25° W., as above given. The vein here is 3 feet wide, and is full of copper. The general slope of the winze is 70°. I measured the temperature of the air and water in this mine, and found—

At 20 feet from the surface the temperature of the water of the mine was 44½° F.

At 120 feet from the surface the temperature of the water of the mine was 44½° F.

The temperature of the air of the mine was 49° F.

The temperature of the air above ground was 42° F.

These observations, compared with those I had previously taken, show a uniform temperature, not far from the mean temperature of the climate and that of the great lake, exists in this mine.

By measurement of the outcrop of the sandstone which underlies the perpendicular shafts made in this mine, the thickness of the sandstone beneath was estimated at 75 feet. By actual perforation of it under the direction of Mr. Childs, the thickness was proved to be 72 feet. The accompanying diagram will explain the position of the trap and sandstone at this mine.

Before leaving for Eagle Harbor, the barometer was observed at Copper Falls.

At Copper Falls, at noon, B. 29.145; T. 6° C.
2¼ p. m., B. 29.182; T. 5½° C.
4 p. m., B. 29.162; T. 5° C.

We then walked to Eagle Harbor, where—

At 5 p. m., B. 29.410; T. 4° C., t. 36° F.
7¾ p. m., B. 29.380; T. 1½° C., t. 33½ F.

We saw Mr. Nichol Stautenburg, agent of the Northwest Company's mine, who promised to send me a statistical account of the mines under his management, in the course of the winter, but I have not received his report.

Dr. Gibbs arrived at Eagle Harbor, and we took passage in his boat to Copper Harbor, meeting my boat at Agate Harbor, where she had been detained by head winds.

September 28.—We removed our articles from Fort Wilkins to Mr. Brockway's house, and left the articles we should require next season, at his store. Our boat was put into the store at the fort, and we are now prepared to return home, having accomplished all the work we can do this season.

September 29.—We await the arrival of the propeller, which is to make her last voyage to the Sault Ste. Marie for this season.

September 30.—We left Copper Harbor, in the propeller, for the Sault Ste. Marie. On our way across the lake, I took the temperature of the

ter of the lake in latitude 47° 20′ 30″ north, longitude 86° west. The nperature of the air at 8 a. m. being 44° Fahrenheit, that of the water is 43° F. Comparing this with previous observations, it will be found at the lake has a nearly invariable temperature, which is that of the ean temperature of the climate of that place.

October 1. —We have been beating against a head wind since we set t on our voyage. When in the middle of Lake Superior, I took four ttles of water of the lake for analysis, the results of which are given in is report.

October 2.—This day we reached the Sault Ste. Marie, and remained ere until the 6th, when we left for Mackinaw in the steamer "Detroit." Mackinaw we met with Messrs. Foster and Hill, who had just ar-ed from Green Bay, and were on their way home. When the steamboat Superior" arrived we took passage from Mackinaw to Detroit, and ched that place on the 9th. Called on the surveyor general to request wnship plats of Isle Royale, and such other township plats as had not en sent to me. Left for Buffalo, where we arrived on the 10th, and at ston on the 13th.

My assistants went home by various routes—some by Canada; others rough Ohio, &c.; so that it was some time before they all arrived and re ready to prepare their synopses, to accompany mine. I requested em to send in, as soon as possible, their reports. Mr. Foster sent me a ter, as requested, from Green Bay, and Mr. Whitney sent in his synop-, both of which were communicated by me, with a short account of the rvey for the season, as required by my instructions. Thus ended the rvey for the season. All was accomplished that was required, except-g the further exploration of the iron ore district, between the Lakes ichigan and Superior, and an examination of the mines on the Ontona-n river, which I proposed to visit myself the next season, in order to clude an account of them in my report on the copper mines. I proposed send to the iron ore district a scientific and *practical furnace-master*, ho was prepared to give a judicious opinion as to the practicability and onomy of manufacturing iron in that region, and to visit myself every cality of economical importance before closing the survey.

I requested the honorable Secretary of the Treasury to ask for a small ldition al appropriation, which, added to the balance unexpended, would ave enabled me to complete the work in a manner satisfactory to the iblic and to myself. I had asked for an appropriation of $6,000, and ongress liberally granted $8,000; so that we should have had more than ough to have carried my survey to completion.

It is well known that my plans were frustrated, in a manner little ex-ected by me, and my work is left incomplete from no fault of mine. I ave done all I could with the few materials left in my hands, and here-ith present my own personal observations; and the reports sent in by my te assistants, J. W. Foster and J. D. Whitney, jr., are appended, with-t any alterations or corrections. Their relations to me will serve to xplain some of their *representations*, on which I shall forbear to com-ent.

Remarks on mines of native copper.

Mines of native copper are quite rare. The only ones of any extent, xcepting those on Lake Superior, are in the Ural mountains, in Russia, nd there the masses are of moderate size.

Small pieces, resulting generally from the decomposition of sulphurets, are found in the mines of Cornwall, and near the surface in the copper mines of Cuba.

In the trap rocks of America, we find native copper in Nova Scotia, Connecticut, and New Jersey; and within the arctic regions of this continent, large masses are found on the Coppermine river. Sir John Richardson says that large masses of native copper were carried from Copper mine river to England thirty years ago, and that masses of the pure metal are frequently met with in that extensive trap range.

No place in the world has thus far produced such astonishingly large masses as the country on the south side of Lake Superior, where the metal exists in regular veins, from which large elipsoidal masses of pure copper, weighing more than eighty tons, have been excavated. It was generally supposed that these veins would run out, as they were wrought to a considerable depth, but thus far no signs of their exhaustion have been seen: on the contrary, the quantity of metal in the lodes steadily augments, and the thickness of the masses increases.

I shall now describe the method of extracting the copper by mining operations. When by shafts and levels the mine is properly opened, the operation of *stopeing*, or working by grades, commences in the lower levels, and a wall of copper is laid bare on one side by blasting away the veinstone and rock. After a mass is thus uncovered, it is followed to some place where its continuity is broken, and there an excavation is made behind it, and the mass is cleared as much as possible all around its edges. Then a heavy blast of gunpowder, frequently amounting to a *hundred pounds*, is placed behind, and tamped with sand, and fired by a long fuse, the miners all ascending from the mine at the time. The blast being fired, the copper is torn from the walls and thrown down upon the "*stolls*," or scaffolding, and is there cut up into pieces that can be readily moved by the chains from the horse-whim. Then the masses are raised from the mine, and removed on a tram-road to the depot. The smaller masses, which are most frequently raised—not requiring to be cut up—along with the rock and veinstone filled with copper, are sent up in "*kibbles*," or tubs, raised by the horse-whim. This is the common method pursued in the native copper mines. From the Cliff mine on Eagle river, about 860 or 900 tons of copper, averaging 65 per cent. of pure metal, is raised per annum; and much of it is quite pure copper, requiring only fusion to cast it into the forms required for the manufacturer.

Method of mining for native copper.

The usual processes of mining are generally pursued in opening the veins of native copper; but the peculiar character of the lodes causes some variation in the miner's operations. Many of the ideas brought from the mines of Cornwall are found to be inapplicable to this novel kind of mining; and those guides which are considered reliable in Europe are here found unavailing. Instead of great masses of "*gossan*" and "*fluckan*," the miner here finds at the surface a clean, well-defined vein of prehnite, containing fine scales and small particles of native copper. Mindic, or iron pyrites, does not mingle with the contents of the vein; and the minerals accompanying the copper are entirely different from those of European mines. Instead of oxide of tin, mixed with a lode of copper

rites, the miner finds here pure silver, imbedded in solid copper, or ixed with the veinstone. Minerals which he does not know the name are continually meeting his eye, and he feels that he is in a new *country*," where the rocks are not killas and granite, with porphyry- vans, but trap rocks and sandstone, exhibiting all their various admix- res and alterations, effected by fire. Beginning with a series of new inerals, he learns from mineralogists who visit the mines their names d characters, and as it were begins the study of mineralogy while ex- oring for mines. The superintendents, properly instructed as to the ture of the minerals, call them by their scientific names, and the anti- ated jargon of the Cornish miners gives way to the language of science. his will be remarked by every mineralogist and geologist who visits the ines of Lake Superior; and I will venture to affirm that nowhere will find the miners better acquainted with the true names of the minerals the country.

Mode of opening a mine.

After making superficial explorations determining the course and dip the vein and the contour of the ground, the miner makes the arrange- nts for extracting the ore or metal. If his ground permits his first rking to be in the side of a hill or cliff, he opens a drift or level into e hill side and penetrates the vein along its course, excavating a gal- y 4 or 5 feet wide and 6 feet in height. Near the opening or mouth his gallery the materials are generally loose, and require supports of mber; but, on penetrating into the solid rocks, he finds them sufficiently m to sustain themselves, so that no timbering is required. The frame- rk supporting the loose materials at the opening of the drift is made strong timber, as represented in the annexed drawing; which requires further description. When a gallery is of considerable extent it is oper to lay a train or narrow railway for the transportation of the ore d rocks, by means of a chariot; but in temporary works a plank laid the bottom of the gallery makes a sufficiently good road for the wheel- rrow, which is generally used in such excavations.

A similar method is pursued in the construction of an adit level, for aining the water from a mine. It is necessary that this gallery should ve a gentle slope, just sufficient to enable the water to run from it; and is customary in wet mines to sink a shallow channel in the bottom of e gallery for draining off the water, and to cover this channel by a nk. In excavating the gallery, as in other mining in hard rocks, npowder is used for shattering the rocks, and much skill and experi- ce is required to produce the most efficient blasts. The holes for sting are all made by means of steel drills, held by the hand, and driven th a hammer and sledge, churn drills, such as are used by quarrymen, ing never employed by miners, they being only suitable for drilling rpendicular holes on the surface, while the miner has to drill in every rection, and generally at an angle considerably inclined from verticality. hen the rock has been shattered by the blast, it is broken up by means of e sledge, and is transported in wheelbarrows or in chariots from the gal- y, and the ore or metal is picked out from the rubbish and placed in a parate heap. The first drifts made on the vein are to be regarded as eliminary researches in most cases, for it seldom is advisable to open a

work of stopeing or by grades near the surface, but to reserve those operations for the deep levels, which are sent off from the lower part of the perpendicular shafts; and no stopeing should be nearer the surface than 60 feet, until it is decided to work out and abandon the mine.

Shafts.

In all regular mining, two shafts are required, and they are generally sunk perpendicularly either on the vein or in such a manner as to cut the vein at a certain distance from the surface. If the vein is but slightly inclined from the perpendicular line, and is not decomposed or leaky, the shafts are sunk directly on the vein; but if the inclination depart considerably from the perpendicular, it is best to sink them so as to cut the vein about 60 feet from the surface, where the first level will be sent off along the line of the vein. If two shafts are sunk at the same time, levels may be sent off in two directions from each of them, and at the same time the party of miners in the shaft continue to sink it deeper: thus more ground is opened at once, and more men can be employed in mining. When the two shafts are connected by a level, ventilation is readily secured by causing an ascensional current of air to pass up one of the shafts, while the surrounding air penetrates by the other, and by the adit level when that is constructed.

A plan of the usual form of a mining shaft is represented in De Beaumont's Coup d'œil sur les Mines, plate 1, figure 3.

The shafts sunk in mining on Lake Superior are generally about 6 feet by 8 feet at the commencement of the operations, and are subsequently squared down and enlarged, when they are converted into engine shafts. At first the miners descend by the rope running over a windlass, placing one foot in a loop made by turning the rope under a hook used in raising the tub; but when the shaft is further advanced, regular ladders and landings are placed at intervals of about thirty feet on one side of the shaft; and in one corner the pump is placed, while the tub or kibble descends in the central division of the shaft, or on one side of it. A frame-work of solid timber is constructed around the orifice of the shaft, and a pulley over its centre is fixed for a rope or chain connected with a horse-whim or perpendicular drum, moved by horse power. By this machine the ore is raised from the mine, one or two horses being attached to a large horizontal lever, moving the drum on which the rope or chain winds. As yet no steam-whim has been erected at any of the mines for raising the ore, the only steam-engine now put up being a small one, driving the stamping mill at the Boston and Pittsburg Company's mine, at the Cliff on Eagle river. It will soon be necessary to erect a good and substantial steam-engine, for raising the ore and metal and for pumping water from the mine. Horse pumps are now employed, the mine not having much water in it. The firmest machinery that has been put up is at the North American Company's mines on Eagle river, where the frame-work is made stronger than at the Cliff mine, and is very well arranged after that model, and somewhat improved beyond it.

After sinking the shaft to the depth of 60 feet, as before observed, the first level is sent off in the vein; and when the shaft reaches 60 feet deeper, another level is sent off in the same manner; and from this the regular operations of *stopeing* or stepping out the ore or metal are begun, by working out the "backs of levels," as the miners call them. Thus

work is begun by cutting out the vein so as to make a series of in-
ted steps, and the ore or metal is thrown down with the veinstone
›n a scaffolding of heavy timber, called by the Cornish miners
'ls, (stools,) and by the French "echafands," (scaffolds.) These
lls are made by fixing large but short pieces of timber into the sides
the vein walls, and are very firm, so that they will bear a great
ght. They are allowed to remain with the heaps of rubbish on them
he work proceeds, and thus the excavation made below is gradually
d up with rock too poor in metals to be worth raising from the mine.
mine does not generally begin to produce profitably until a consider-
extent of stopeing ground is opened, and room is thus provided for
ers to excavate the vein rapidly.
Unfortunately, people interested as stockholders in mines know but
e of the business, and too frequently abandon these mines before they
in a state to give any economical results; and this is the cause of so
ıy good mines having been abandoned, when, by perseverance and a
ral outlay of money, they might have been rendered profitable.

Adit levels.

n all cases where the ground will permit an adit level to be made along
line of the vein, and to a sufficient depth—say at least to the depth of
y feet—it is advisable to begin by making such an adit while sinking
first shaft, so as to drain off the water readily, and to secure ventila-
. If, however, the adit should be of too great a length and too ex-
sive, the method above described of working by two shafts at first
uld be preferred, and the water can be raised by pumps or by the tub
horse-power. If an adit would run through rocks not containing ore
netal, the distance it must run and its effect must be calculated, so as
ıscertain whether it would prove a profitable operation. Generally,
h an adit should not be made until the vein has been sufficiently
ved to justify the outlay. Many a mining company in this country
been ruined by the expense of making long adits, without counting
cost, and before proving the value of their mine. All these matters
be best decided upon by a good mining engineer familiar with the
ıe in question.

Ventilation of mines.

Various methods are had recourse to for ventilating mines. In winter,
cold air of the surface readily penetrates into all parts of a mine, and
places the warmer air; but in the summer, when the air at the surface
warmer than that in the mine, the air of the mine is not displaced, and
n becomes irrespirable, and incapable of supporting the flame of a
ıdle. This corruption of the air is effected by the burning of candles,
ng of powder in blasting, and by the respiration of the miners; more
ely, carbonic acid gas arises from mineral springs in the rocks.
It becomes necessary, therefore, to secure good and sufficient ventila-
ı in a mine, and various machines are employed to effect this. The
-bellows is commonly employed at first, to blow down fresh air; but
s is a very inefficient method in deep mines. In England, Taylor's
nging cylinder, resembling a gasometer, is employed to draw the air
of the mine, and is regarded as the most efficient machine. In coal
ıes, a powerful draught is effected by means of a fire built in a furnace

connected with the shaft: an ascensional current of air being produced, fresh air pours into the mine.

The best machine that I have seen for ventilating mines was constructed by Mr. Hezekiah Bradford, of New York, and is now in action at the Bristol copper mine in Connecticut. The machine is nothing more than a large air-pump fixed over one of the shafts, and consists of a square plank box, with a series of lids or valves forming its bottom, and all opening upwards. In this box is placed a piston, moving easily in the box, and having greased leather bearings against the sides of the box. This piston is made of a frame with light board valves covering its entire surface, and all opening upwards. An iron rod passes from a wheel having a quadrant movement, directly over the box, and is connected with the movable piston. The wheel, moved by a small rod extending to the lever of the steam-engine, works this pump with ease and efficiency, and draws out the air from the mine with great rapidity, the box being fixed air-tight over the ventilation shaft. This is the simplest, cheapest, and most efficient ventilating machine I have seen, and I would recommend its introduction generally. It is certainly preferable to Taylor's plunging cylinder, which requires more power to move it, and an extension of the draught-tubes into the mine. It is of great advantage to get rid of these tubes, which are exposed to injury from blasting and to many accidents.

Preparation of ores and cleansing metals from rock.

After raising such ores to the surface as are regarded to be sufficiently rich for working, the richest pieces are picked out and thrown into a heap, and if of sufficiently high per centage to be profitably transported to market, are barrelled up and forwarded. There still remains by far the largest portion of the ore too poor to bear the expenses of transportation, and this has to undergo certain operations to render it merchantable. I shall describe the methods employed in cleansing the metals from veinstone and rock. The pieces which are raised to 30 per cent. of metal by beating off the rock are packed up in barrels, and this metal is called "*barrel-work*." There remains a large portion of rock filled with small particles of metal called "*stamp-work*," which is to be cleansed by the action of the stamping mill, and by certain operations with water. The ore or rock containing the metals is first broken into pieces about twice the size of man's fist, and then is thrown into a hopper or box having an inclined spout leading beneath the stamp heads. A current of water passing down this spout, and the jar produced by the action of the machinery, gradually carry the rock under the stamps. The rock is there beaten fine by reiterated blows of the stamps, which weigh about 300 lbs., and drop about 15 inches at each blow, driving down a portion of the rock to form its bed, which is confined by cast-iron plates and gratings. The rock is pulverized in water, so that it is converted into mud or slime, and is carried off by the current. The particles of copper and silver which are capable of passing the grating are also swept from underneath the stamps, and pass over a plank apron to the vat, where the metals and heavy particles of rock subside, and the running water carries off the slime as mud. When this vat becomes filled with the metals and rock, the water is run off, and the contents are removed to "*strakes*" or washing troughs, where by stirring with a shovel, while a rapid current of

ater is passing through the mixture, the rock is mostly washed out, and ıe heavier metals remain at the head of the *strake*, and are thrown out) be farther cleansed by the *jig-men*, who shovel the metals and rock ıto sieves made of perforated sheet copper or iron, and then sink them ıto a vat of water, and by a peculiar and gentle motion of raising and)wering the sieve, and by a partial circular motion, the copper and silver re made to subside to the bottom of the sieve, and near its middle. The)ck is then scraped off from the surface until the metal is exposed. he sieve is again filled with the ore, and the operation is repeated until sufficient quantity of clean metals has been obtained, which are then emoved into barrels placed ready at hand to receive them. The Cornish ashers of copper ores are very skilful at this business, and raise the amp ore to 80 or 90 per cent. of metal very easily. The fine particles hich pass through the sieves are next submitted to the operation of the *eeping-table* or of *kieves*. The sleeping tables are plank platforms, ightly inclined, with a gentle current of water brought into the head; nd there the fine ore is placed, and the gentlest possible current of water allowed to pass over it, while it is stirred by means of a peculiar nar-)w bent spade, or by a rake and hoe—the former tool being used by the ornish ore washers. The current of water gradually removes the ghter earthy particles, and the heavier metals remain at the head of the ble, and are gathered into a heap and packed in casks for shipment.

Another method is also used to separate the fine particles of copper. he mixture is thrown into a large tub of water, which is rapidly stirred y means of a spade, a spiral motion being given to the water. The cop- er and silver having a higher specific gravity than the rock, settle to the ottom first, and the water being run off, the rock is skimmed from the rface, and the metals are found at the bottom sufficiently clean for ship- ent.

radford's sifting and winnowing machine for the separation of copper ore.

I lately had the pleasure of examining a newly invented machine for leansing copper and other valuable ores at the Bristol copper mines in onnecticut, and would call the attention of miners to these valuable nprovements.

The ore is first crushed by powerful, hard, fluted iron rollers. It is then creened, and the fine ore is allowed to pass. The coarse ore is taken up y lifts, inside of a revolving wooden wheel, and brought up to a trough a ttle at a time, and thus fed into another set of rollers by a spout. It is ius reduced still finer, and is now allowed to pass through a drying ylinder, which is placed in an inclined position, and has a revolving ıotion; while it is kept hot by a current of waste steam, aided by a fire t the head of the cylinders. The ore passes down this revolving cylin- er and reaches the other end quite dry. By lifts similar to those of ouring mills, the ore is next taken up and carried to the sieves or creens, which are so constructed as to act exactly opposite to the usual ıethod of sifting, viz: by discharging the coarse ore first, and thus pre- enting the wearing of the sieves by the passage of the coarse ore through ıem. These screens revolve and sift out the coarsest particles first, ıen to the next, and so on to 30 different sizes, throwing out the finest ast at the termination of the sieves.

There are as many compartments to receive the sifted ore as there are sieves, and thus the ore is sorted and is now ready for the next operation, which is a new method of separating ores by means of a current of air properly regulated. The sifted ore being placed in an inclined trough, is gradually delivered, by the rotation of a cylinder with a series of lifts of sheet tinned iron, into the winnowing chamber, where a regulated current of air is made to pass by means of a large fan-wheel, driven by the steam engine, and forcing a steady current of air along a chamber 90 feet in length. The ore delivered by the machine is winnowed, and the heavy ore is found in one compartment, quite clean, and the poorer a little further from the blast, and so on until we find no trace of the ore, but merely the rock blown out of it. Having seen this machine in operation, I am satisfied that it can be advantageously employed on Lake Superior for the separation of copper and silver from the pulverized rock, and it will also serve to cleanse ores that are now regarded as too poor for either shipment or for washing; an ore containing 2 per cent. of copper being profitably cleansed by this machine. It could be very advantageously employed at the Lac la Belle mines in cleansing the gray copper ore of the poor veinstone—the product being about 6 per cent. The great heaps of copper ore at the abandoned Suffolk mines, which contain from 6 to 8 per cent. of metal, may also be cleansed by this machine; and provided the machine was put up at some place where the ores from the various mines could be concentrated, the work would doubtless prove profitable. Mr. Bradford informs me that, by means of his new machine, he can cleanse 40 tons of ore per day, and that it requires only four men to work it.

It is obvious that machinery like this is admirably adapted to working the gold earth of Virginia, of the Carolinas, and of California.

It being the first successful American improvement in machinery for cleansing ores, I hope it will have a fair trial wherever it is applicable.

At the Bristol copper mines I also saw a most ingeniously contrived steam-whim, which is also new, and is by far the best I have ever seen or heard of. It has the power of instantaneous reversion without reversing the engine, and thus avoids interference with the power of the fly-wheel, and saves a great deal of power, while it is under the most absolute control of the man at the engine shaft. In discharging a kibble or tub there are required six motions in opposite directions, and all these are effected by one man, without any difficulty, by the mere movement of a lever acting on the reversing power of the wheel over which the chain revolves, and carries the two kibbles. This is all effected by one of the most simple contrivances. There are two bands running in opposite directions, and moving an axis with friction wheels in opposite directions. By means of a lever these are alternately brought to bear upon cog-wheels, which play into an endless screw which is connected with the chain-wheel. This change of gear is effected by means of ropes coming from two levers placed at the ends of the movable axis. It was also observed that when a tub got caught, the machine would slip so as to avoid breaking the chain, and thus also notify the man at the mouth of the shaft that there was some obstruction, when by change of motion the kibble would be instantaneously liberated. It was found easy to reverse the motion, by the above arrangement, 10 times in a minute. I

ıld commend it to miners as a most useful improvement, and as well pted to the wants of the miners on Lake Superior.
ince no steam-whims have as yet been erected at any of the Lake Su- or mines, it will be advisable to examine the machinery I have here :ribed before putting up the engines, which will soon be needed, espe- ly at the Boston and Pittsburg Company's mines, which have already ined a considerable depth.

'ent of the copper and silver bearing rocks on the mineral lands of the 'nited States in Michigan, with some remarks on the theory of the ori- in of the metals.

'opper and silver occur on Lake Superior mineral lands in the trap :s only, and the valuable veins are limited to a narrow belt of the 'gdaloidal variety of that rock; for when a vein penetrates into the pact trap, it soon pinches out or becomes a mere sheet of metal un- thy of the expenses of mining for its extraction. The sandstone and glomerate rocks which border the trap range, limit the extent of the alliferous veins by cutting off the lode, calcareous spar being found in sandstone as a continuation of the vein. Thus we are enabled to rmine the length of the workable veins by the width of the band of 'gdaloid, which lies between the compact trap and sandstone rocks, is the product of the interfusion of those two kinds of rock. The rse of the true veins is nearly transverse to the direction of the trap- ı band, and the length of a workable vein has thus far never been ed for more than 2,000 feet in extent. Their depth is supposed to be r great; probably the copper will be found to extend below the sedi- ıtary rocks. Since this metal appears to have originated from the in- or of the globe, we see no reason why the veins should cease to con- metal and reach to greater depth. Indeed, we have reason to believe the proportion of the metal will increase as we proceed towards its inal depository. Experience thus far seems to sanction this belief.
eological science has not yet been able to account for the facts, that nature of the rocks decides the character of the veins traversing them; that with a change in the rocks there is also a change in the nature metalliferous lode of the same vein traversing different kinds of rock. have we yet been able to account for the peculiar character of the ıs accompanying each kind of rock, or why trap rocks cutting through :stone should bear lead and zinc ores, while they are accompanied by ı and copper pyrites in slate, and copper in sandstone. We can readily ceive why metalliferous veins should accompany the outburst of an eous rock, but we do not understand why there should be, as it were, ; *selection of metals by the overlaying strata*, which one would think ld have no influence over matters originating below them. Apart n all theory we may state the facts observed, and in the course of time ıe clue will be found by which the mystery may be penetrated.
'opper and silver are both, in the present state of our knowledge, ele- ıtary bodies; perhaps they are amongst our best ascertained elements, hence it is not to be supposed that they were formed from any ingre- ıts of trap or sandstone rocks. We are forced to regard these metals rimary constituents of the planet; and from the occurrence with hy- :ne rocks of igneous origin, we are disposed to believe that they some-

how were produced by igneous agency; but whether the metal was sublimed in the state of vapor or in some volatile combination—as, for instance, the chloride—and was separated from the chlorine by galvanic or some other agency, or was thrown up into the chasms in a molten state by igneous agency, we cannot positively decide. From many observations already stated in this report, it would appear that there is strong evidence against the injection of the copper as a molten mass; but although we may disprove that theory, we are by no means prepared to substitute another which will be found free from defects. I would, however, call attention to the fact first noticed by me on Lake Superior, that where there are the greatest number of alternations of sandstone and trap, the amygdaloid contains the richest veins of copper and silver; and I would refer to the mines on Eagle river and at Copper Falls for proofs of this statement.

It would appear that the series of alternate bands of trap and sandstone may be regarded as the elements of a galvanic battery, provided the conditions required for the development of electric currents could be shown to exist in those rocks. May it not have been during the very long period in which the trap rocks retained their heat—which must have been for many years—that there was a *thermo-electric* current produced among these rocky plates—the disjunctions in the chasms polarizing the currents? I would not attach much importance to this hypothesis, but throw it out as one of the possible solutions of the question I am considering—of the deposition of copper and silver in the veins which traverse the amygdaloidal trap. In 1844–'45, I ascertained that at least six alternations of the trap and sandstone rocks occur near the Copper Falls copper and silver mine, and that numerous similar alternations of these rocks exist near the mines of the Lake Superior Copper Company on Eagle river. During this survey, my sub-agent, George O. Barnes, ascertained by patient investigation that there were eleven narrow bands of sandstone, conglomerate, and trap rocks between the mouth of Eagle river and the mine.

At the Boston and Pittsburg Company's and the North American Company's mines, on the southwest branch of Eagle river, the sandstone is not exposed; but a vast bed of amygdaloid, resulting from the combination of the trap and sandstone, is the rock containing the copper and silver of those mines; and it is highly probable that belts of sandstone will be found near the base of the hill, or in the unexplored flat lands near the stream.

At Eagle Harbor there are also intercalations of sandstone in the trap, and amygdaloid is most abundantly produced. The same remark applies to the Northwest and Northwestern Copper Companies' locations, and to *nearly all the localities where rich veins of copper have been found* on Keweenaw point. It has been found impracticable to represent each of these bands of sandstone on the geological map, for they are too narrow to introduce upon a map of such dimensions as should accompany this report. I have therefore described them here, lest it might be supposed that I had overlooked them, and did not appreciate their importance. I would also remark that, while the northern side of the great trap belt on Keweenaw point is made up mostly of hornblende and felspar, mixed in proportions usual in brown trap rocks, and is highly amygdaloidal along the line of junction with the sandstone and conglomerate,

he southern side is of quite a different character, and resembles orphyry in having a compact felspar base, with crystals of felspar nbedded in it, and but very little hornblende. This southern margin is lso remarkable for containing the *gray sulphuret of copper*, instead of ative copper; and if the rock was not connected with the more hornlendic trap, and in the same line of direction, bursting through the ame kind of sandstone strata, I should feel disposed to regard it as of nore *ancient origin*. Indeed, I am far from being satisfied that it is not nore ancient, for the limited exposure of the rocks does not allow any eologist to be too confident in his opinion respecting its age.

At the Lac la Belle mines—as will be noticed in my description of that ocality—the rock is so highly crystalline as to resemble some varieties of ienite, and it not unfrequently contains a large admixture of chlorite, nd has been mistaken for protogine rock. A similar rock occurs at the ake Superior Copper Company's mines on Eagle river, and is cut hrough by the copper vein, bearing much dark brown trap rock with it, nd thus indicating that the vein is more recent than the chlorite and elspar rock.

From the above considerations, we may regard the amygdaloid on the *orthwest side of the trap belt as mineral land containing numerous veins f copper*, mixed with variable but comparatively small proportions of silver. The central portion of the belt contains comparatively but few valuable eins, and only where the trap is amygdaloidal. The southeastern margin f the belt contains but little native copper; but, instead of it, gray sulhuret of copper occurs both in *stock-werkes* or cotemporaneous veins nd beds, and in well-defined veins, which are occasionally sufficiently ich for mining, but are more frequently poor.

The extent of the copper-bearing trap rocks is about 120 miles, or from he extremity of Keweenaw point to the Ontonagon river; and its average idth is less than five miles. All the good locations for mining have already een selected by those enterprising men who first penetrated these forests nd opened mines. A few have been successful in these operations; but nany have spent both time and money freely, and have met with no eward. I have designated the whole of the trap range as mineral land; ut there are only few places left for mining enterprises, for the country as been pretty thoroughly explored, and the best locations have been elected. With the progressive settlement of the country, I have no loubt, new veins will be discovered along the trap belt which I have escribed; and it will be of advantage to the country to offer all proper nducements to settlers, and not to restrict their selection of land by any eservation of certain tracts as mineral land. Let all who choose to settle here purchase at the price of agricultural land, and enjoy the benefit of ny mines they may chance to open upon their estates. *It may be useful o the public to cause geological and mineralogical surveys to be made for heir information; but I am satisfied that the reservation of mineral lands s a great evil to the country, and that the government never can derive evenue from such sources, while the restriction most seriously embarrasses he settlement of newly acquired territory.* The above remarks are applicable to the whole copper region, and *I would not advise the reservation f any part of it as mineral land.*

Isle Royale

This island has the same geological character as Keweenaw point, and is of the *same geological age*. The veins of copper occur mostly near the junction of the trap and conglomerate and sandstone rocks, or in the amygdaloidal trap. More frequently the veins are imbedded veins of epidote running parallel with the *trende* of the trap rocks. Small veins traverse the line of direction, and intersect the small beds, showing thereby a more recent origin. Only one mine—that at Todd's Harbor—has, at yet, produced any considerable amount of copper, and but few of the veins have been opened to a sufficient depth to prove their value. The island is unfrequented, and is a most unpromising place for settlers at present, there being no communication with the other and more settled portions of the country and this island during the long winters of that country. If adventurous persons chose to purchase lands and settle there, *I should most strenuously advise the government to offer no obstructions by mineral reservations*. A settler is justly entitled to all he finds if he is willing to live there.

The soil of the island is good, and the timber is sufficiently abundant and sound. The harbors are beautiful and secure, and the fisheries are the best on the lake.

When the island is settled, and the soil cultivated, it will be a very habitable spot; but at present the difficulties I have alluded to prevent permanent settlement.

The trap belt on Isle Royale is, on an average, five miles in width and nearly fifty in length, and is bordered on the southwestern side, near the western extremity, by sandstone rocks. Conglomerate occurs along the line of junction of the sandstone and trap, and upon the coast along most of its southern side; but on the northern side, cliffs of trap, somewhat amygdaloidal at their base, exclusively prevail. Numerous small streams and pretty lakes exist in the island, and ridges of trap rocks extend in a linear direction from one end of the island to the other. On the immediate coast, the forest trees are stinted by the cold air of the lake; but the growth is open, mixed, and heavy, inland, indicating a fertile soil.

Transportation of the copper from Lake Superior eastward.

The copper obtained from the mines on Lake Superior is shipped in vessels to the Sault Ste. Marie, and is there landed and transported across the portage (one mile) in wagons. Thence it is shipped, and is transported through the lower lakes to the Erie canal, and brought to the seacoast, or it is taken by vessels to the canal in Ohio, and is sent thence to Pittsburg by canals and the river.

The cost of delivering the copper to the cities on the Atlantic coast, I was informed by the mining and forwarding agents, is about $15 per ton.

Chemical researches on the native copper of the mines on Keweenaw point.

In the first place I wished to determine the specific gravity or density of this native copper, and I procured a slice from the great mass at the Copper Falls mine, the piece being sawed and never hammered, or in any

rtificially compressed. I sawed out a cube of this copper and took cific gravity:

It weighed in air - 4.778 grammes.
" in water 4.243 "

Difference .535 "

.535 : 1 :: 4.778 : 8.9308 = specific gravity of the Copper Falls

s piece of copper was then analyzed. No trace of gold was left in tric acid solution, and no silver was found in it by testing with hydric acid, or iron by testing with ammonia. It was pure copper. nsity is greater than that of hammered copper, which has a speravity of 8.890, while native copper in European books is stated at

This copper from Lake Superior is therefore more dense and r tough. The mass from which this specimen was cut weighed , and it was equally pure throughout. Its density must be owing perfect metallic contact of its particles, and the absence of either subof copper or sulphur, which frequently exist in copper of commerce.

ic gravity and chemical analysis of the native copper from the Boston and Pittsburg Company's mine.

this examination I employed strips cut from one of the largest s at the bottom of the Cliff mine, Eagle river. This mass weighed ıs. The strips are removed by mortising channels through the copnd was supposed to be condensed by the blows of the hammer, the corrugating the strip as it is raised from the mass. A cube of this : sawed out from the middle of the strip—

Weighed in air - - 156.5 grains.
" in water at 60° F. 138.9 "

Difference 17.6 "

17.6 : 1 :: 156.5 : 8.890. The specific gravity of these strips is, ɔre, 8.890.

is piece of copper was dissolved in pure nitric acid, and left no trace d, and but a minute portion of silex. The solution gave no silver tested by chlorohydric acid, nor iron when tested by ammonia. It ure copper with a little silex included in it. The density is equal t of hammered copper of commerce. The copper from this mine is ınown to be much tougher than that which has been obtained by ial smelting. I could not at that time obtain any specimen of the r that had never been hammered, but I have since sawed from one of ystallized specimens a piece which had a specific gravity of 8.9300, ırly like that from Copper Falls.

e copper when cast into an ingot has a specific gravity of from 8.788 30.

e copper when drawn into wire has a specific gravity of from 8.876 60, according to Berthier.

Specific gravity and analysis of the native silver of the Boston & Pittsburg Company's Cliff mine, at Eagle river.

None of these specimens had been hammered.

First specimen—weight in air - 3.710 grammes.
" " in water 3.348 "

Difference .362 "

As .362 : 1 :: 3,710 : 10.248. The specific gravity of first specimen is, therefore, 10.248.

Specific gravity of a section of a crystal of native copper from the Cliff mine.

This piece was sawed out of a large crystal, and gave as follows:

Weight in air - 2.8085 grammes.
" in water 2.4940 "

Difference .3145 "

As .3145 : 1 :: 2.8085 : 8.9300, the specific gravity.

This specimen, on being dissolved in pure nitric acid and distilled water, left .03 gramme of silex. Hence the corrected specific gravity will be 10.496. No trace of gold was left by the nitric acid. The solution being tested for copper and other metals, gave no trace of their presence; hence the silver was pure, containing only a little quartz mechanically mixed.

The specific gravity of pure silver when cast into an ingot is 10.4743; and the specific gravity of pure silver when hammered is 10.5420, according to Berthier.

Specimen No. 2 weighed in air - 2.588 grammes.
" " " in water 2.335 "

Difference .253 "

As .253 : 1 :: 2.588 : 10.288, specific gravity of specimen No. 2.

Specimen No. 3 weighed in air - 2.700 grammes.
" " " in water 2.435 "

Difference .265 "

As .265 : 1 :: 2.700 : 10.188, specific gravity of specimen No. 3.

Specimen No. 4 weighed in air - 4.515 grammes.
" " " in water 4.070 "

Difference .445 "

As .445 : 4 :: 4.515 : 10.146, specific gravity of specimen No. 4.

These two last specimens were found to contain small particles of copper scattered through them, but the copper was not alloyed with the silver. These specimens of silver were found mixed with the veinstone, associated with native copper. They were in grains from the size of a mus-

d seed to pieces of more than an ounce in weight; most of the pieces :ked out of the stamp work were of the size of a hazelnut. The singu- fact of the occurrence of silver implanted in masses of solid copper, or tting its surface like buttons dropped upon the copper and united by a :tallic soldering or perfect metallic adhesion at the points of contact, is served in this mine, as also at the Copper Falls, Lake Superior, North merican and Northwest Companies' mines. I have analyzed hundreds specimens without ever finding any true alloy of the copper and silver. ı cases where it was first supposed to have been an alloy, it was subse- ıently found to be merely a mechanical mixture of the two metals. Had ıey no affinity for each other, the particles could not have been more parate; but since we know that molten copper and silver readily and ost quickly unite, forming an alloy when they are brought in contact, ıd know also that the copper requires a much higher temperature for its sion, it is difficult to conceive that the metallic lode of the mine was posited in a molten condition. As I have observed elsewhere, theory es not reach the solution of the question of the mode of origin and position of this mixture of pure copper with pure silver. One of the ecimens which I obtained in 1844, through the kindness of Mr. Bernard, composed of a mixture as here represented.

Discovery and analysis of the iron ore of the Menomonee river.

During my first visit to Lake Superior, in the summer of 1844, I obtained m Mr. Barbeau, a trader at the Sault Ste. Marie, a fine specimen of ecular iron ore, which he had received from the Indian chief on the rth side of the Sault Ste. Marie. I learned also that this chief knew of mountain mass of this ore, somewhere between the head of Keweenaw y and the Menomonee river. In the summer of 1845 I advised Mr. rman Pray, of Charlestown, Massachusetts, to look up that mountain, d told him all I had heard from Mr. Barbeau. He immediately em- yed the son of the Ojibway chief as his guide, and went with him to e Anse; and from thence, guided by the Indian, he traversed the forest, d found the iron mountain. I requested him to look for the rocks con- ning the iron ore, and to obtain for me some geological data, and to ng me some specimens. He informed me, on his return, that he had rched four miles around the mountain, and found only this same kind iron ore, and no rocks. To Mr. Pray we are, then, indebted for our first owledge of the extent of this vast amount of iron ore. No linear sur- ys had then been made, and it is probable that no white man had ever ore explored that locality. This bed of iron ore has since been visited my assistant, Mr. Foster, and Mr. Hill, my surveyor, who have given lescription of it in their report, and have furnished specimens of the

Chemical analysis of iron ore from the Menomonee river.

have analyzed the specimen of iron ore which Mr. Barbeau gave me, find it to yield in 100 parts, by weight—

Peroxide of iron	89.70
Silicious matter	12.20
	101.90
Gain of oxygen	1.90
	100.00

The ore is slightly magnetic, and gains weight by being converted into the peroxide of iron. This ore contains 64.48 per cent. of pure iron, and will yield about 60 per cent. of cast-iron when smelted in the usual manner in the blast furnace.

The specific gravity of this ore was found to be 4.903, and the weight of a cubic foot of it is $306\frac{4}{10}$ lbs.

In the course of time, this great mass of iron ore will be worked. At present the want of a road to the location, and the wilderness state of the country, are the obstacles to be overcome. The ore will make excellent bar iron by directly smelting it in a Catelan forge, and may be worked in a small way for the supply of the miners and inhabitants on the borders of the lake. The only fuel that can be obtained for the smelting of the ore is charcoal, and the forests will furnish a most abundant supply—hard-wood trees predominating in that forest. When the country has more population, and roads are made from Green Bay to this iron ore, blast furnaces may be erected, and an extensive business will be created in that country. The ore is as rich as is desirable, and will make the best kinds of cast and wrought iron. Limestone occurs in the vicinity, and will serve for a flux in smelting the ore.

In 1845 Mr. Joseph Stacy, of Maine, explored the iron ore in that portion of the country between the mouth of Dead river and Lake Michigan, and established the fact that there was an inexhaustible amount of compact and micaceous specular iron ore in that district. I have not the description of the localities he visited, but I saw, when at Copper Harbor, the specimens he brought from that place. Since then, I obtained from Mr. McNair a good specimen of the ore from near the forge called the Jackson Furnace. This ore was analyzed by my assistant, Mr. Geo. J. Dickenson, of Boston, who found it to consist of—

Silica - - - -	3.88
Lime - - - -	0.17
Peroxide of iron	96.11
	100.16

A small portion of this ore is in the state of magnetic oxide. This ore contains 66.636 per cent. of metallic iron, and will yield 60 per cent. in the blast furnace, the ore being estimated somewhat lower when worked in mass. It is converted directly into bar iron in the Catelan forge, and makes the best quality of iron. The locality, being the nearest point to Lake Superior, where the iron ore exists in large quantities, will be regarded as one of the most available.

This locality was more thoroughly examined by Dr. John Locke, assistant geologist, and Dr. W. F. Channing, sub-agent, in 1847, and will be

described in Dr. Locke's report, which he has been requested to forward to Washington in season to be printed with this report.

Iron ore from Carp river.

This ore was brought to my laboratory during my absence on the survey, in the summer of 1848, by the late Edward Clark, esq., of Worcester, for analysis. It was analyzed by my assistant, Mr. R. Cropley, and found to contain—

Peroxide of iron, 100.14
Trace of silica -

This ore contains magnetic oxide to a small extent, the remainder being specular oxide. It contains 71 per cent. of pure iron, and will yield in the blast furnace about 65 per cent.

Assay and analysis of the washed metals from the jigs at the Boston and Pittsburg Company's mine, on Eagle river.

Through the kindness of Dr. Clarke, I was furnished with an average sample of the washed metals from the Cliff mine stamping works, which was assayed under my direction by Mr. Geo. J. Dickenson, assistant sub-agent. By the usual method of sampling, by quartering, I drew a fair sample of metals from the lot, and this sample, weighing 1,520 grains, was put into Mr. Dickenson's hands for assay and analysis. On fusion into an ingot, the metal obtained weighed 1,290 grains; hence there was 230 grains of earthy matter or rock mixed with metals before fusing. 39.73 grains of this metal sawed from the ingot, submitted to analysis, yielded 0.026 of chloride of silver, or 0.049 per cent. of metallic silver. The analysis repeated on 81.70 grains, yielded 0.053 grain chloride of silver, or 0.048 per cent. of metallic silver. This proportion of silver tends to improve essentially the quality of the copper, preventing its rapid corrosion by sea-water, and it is also less susceptible of oxidation from the action of air. It is doubtful whether it can be economically separated by eliquation by means of lead, but it is easy by hand to pick out all the large particles of silver; and I have learned that this work now furnishes employment for children in Pittsburg, where the copper is now carried to be fused and manufactured.

The presence of silver gives the copper more strength and renders it more valuable for making bronze cannon; and it has been well proved both in France and this country, that cannon made with this metal are unusually tough and strong. It is particularly adapted for casting light field pieces and howitzers, which may be made much lighter than usual, and still be safe. This metal and that from Copper Falls has been used in Boston for making church bells, and has proved to be of excellent quality. When a much larger proportion of silver exists in combination with the copper, it makes it too hard. In some of the samples I obtained in the furnace by smelting the rock of the Lake Superior Company's mine at Eagle river, I obtained buttons of metal which contained 20 per cent. of silver, a quantity worth separating by acids, and which I found I could separate still cheaper by making the alloy into a liquation cake with lead, and then eliquating the silver and lead from the copper, and cupelling the lead for silver, while I refined the copper, and thus obtained both silver and copper. I proposed the method in my report to the Lake Superior

Company in 1845, and fully proved its economical application. The eli quation process is founded on the fact that copper and lead do not unit or alloy, while silver unites with lead very readily; and if the eliquatio cake be heated so as to melt the alloy of silver and lead, and not the co per, the fused alloy runs out and leaves the copper.

Chemical analysis of the green mineral which is the gangue of the nati silver at the Copper Falls mine.

It is remarkable that the silver in most of the copper veins on Lal Superior is associated with a peculiar green mineral, which for some tin we have called green earth, or rock colored by chlorite, &c., but whic I had long supposed to be a new species. I obtained a number of spe mens of it at the Copper Falls mine expressly for analysis, and, after pic ing it clear from copper and silver, levigating and washing it, and th cleansing it from any trace of copper by means of dilute nitric acid, I su mitted it to my sub agent, Mr. Geo. J. Dickenson, for analysis. It w found to consist of—

Silica	57.95
Alumina	19.00
Protoxide of iron	13.06
Lime	.05
Magnesia	1.32
Water	7.81
Loss	.81
	100.00

It is very difficult to obtain this mineral clean from an admixture metals without the action of nitric acid, and it is possible that a portion the lime was removed from it by that acid. It is so much mixed wi carbonate of lime, that it was thought safest to take the mineral cleans by acids for analysis; for it is not soluble in nitric acid, and perhaps is n decomposed in its essential ingredients.

Chemical analysis of a specimen of rock obtained by my assistant, J. F Foster, and marked by him "Basalt from below Chippewa island, M nomonee river."

The analysis was made at Mr. Foster's request by Mr. G. J. Dickenson It yielded by his analysis—

Silica	67.53
Alumina	11.86
Protoxide of iron	10.39
Lime	3.22
Potash	2.72
Soda	2.82
Magnesia	.31
Water	1.35
Manganese, a trace.	
	100.20

A specimen of sienite from the Menomonee river was also analyzed, at the request of Mr. Foster, by Mr. Dickenson, who obtained the following results:

Silica	65.61
Alumina	19.91
Protoxide of iron	11.08
Lime	1.15
Alkalies and loss	2.25
	100.00

These last two analyses took up much time, were tedious, and not very instructive. It is of little use to analyze an aggregated congeries of crystals which make up such rocks, for their ingredients vary in proportions in different specimens so as to give little value to the analysis.

Chemical analysis of a specimen of limestone from township 44, range 31, sections 27 and 28.

This limestone was analyzed by Mr. Dickenson, and yielded—

Silica	2.72
Carbonate of lime	53.63
Carbonate of magnesia	42.87
Oxide of iron	.74
	99.96

Chemical analysis of a specimen of limestone brought from the Menomonee section by Mr. Foster.

It is a compact limestone, slightly buff-colored, and mixed with grains of quartz, and is supposed to be a metamorphic rock. By Mr. Dickenson's analysis of this limestone, it was found to consist of—

Silica	2.35
Oxide of iron	.15
Alumina	1.39
Carbonate of lime	67.42
Carbonate of magnesia (by difference)	28.69
	100.00

In this analysis the presence of magnesia was proved, but it was not wholly separated; hence it is expressed by difference.

This limestone would make a good marble were it not for the occurrence of nodules of quartz included in it, which prevent its being sawed and polished evenly. It will be observed that it is not so magnesian as the fossiliferous limestones higher up in the geological series, as seen in the analysis preceding this.

Analysis of Mackinaw limestone.

This limestone is subgranular and fossiliferous. It exhales a stro odor of petroleum during its solution in chlorohydric acid. It was a alyzed by Mr. R. Cropley, my assistant, and found to consist of—

Insoluble silicious matter	.39
Phosphate of lime, iron, and trace of manganese	1.00
Carbonate of lime	60.58
Carbonate of magnesia (by difference)	38.03
	100.00

Analysis of limestone containing pentamerus oblongus, collected by Channing on St. Joseph's island.

This was analyzed by Mr. R. Cropley, and found to consist of—

Insoluble silicious matter	.80
Peroxide of iron	.20
Carbonate of lime	55.35
Carbonate of magnesia (by difference)	43.65
	100.00

Analysis of limestone from T. 51 R. 35, corner of sections 13, 14, 23, a 24, collected by Mr. Whitney.

One of the specimens contains an obscure fossil of the pentamerus longus. The analysis was made by Mr. R. Cropley, who found it co posed of—

Insoluble silicious matter	8.91
Peroxide of iron and manganese	1.98
Carbonate of lime	44.49
Carbonate of magnesia	44.65
	100.03

This limestone, like that of Mackinaw, exhales a strong odor of pet leum during its solution in chlorohydric acid.

Assay and eliquation of a sample of the ore sent to the Roxbury laborat in 1846, by the Boston and Pittsburg Mining Company.

This sample was given to me by Dr. Ball, with the request tha would separate the copper and silver by the process of eliquation. T ore was not regarded as an average sample of the contents of the vein, was sent to Boston for experimental researches. In preparing this or took care not to lose any of the metal, and therefore did not wash it up so high a per centage as could have been effected.

2,000 grains of the pulverized ore on being washed was reduced to 1,; grains, the fine rock alone being separated. This washed ore was t

olved in pure nitric acid, and the silver and copper were separated, and unted to 80.8 grains of copper and 2.05 grains of silver. Another ple weighing 14,586 grains was reduced by washing to 1,380 grains, was then melted with a proper flux, and yielded 340 grains of an alloy opper and silver. This was melted with 700 grains of metallic lead, nitted to eliquation. The alloy of lead and silver was cupelled, and 3.85 grains of silver, or 1.33 per cent. The copper was melted and ed from the lead, and contained a little silver which had remained in adherent lead. This process is therefore applicable to even the poorer s of argentiferous copper, and will serve to separate most of the silver. eliquation process will succeed better on a large than on a small scale, a better result may therefore be expected when proper furnaces are tructed for the working of these metals in the large way.

mical analysis of the green hydrous silicate of copper or chrysocolla from Copper Harbor.

his sample was picked as clean as possible, and yielded, on analysis of grains—

Silicic acid	37.85
Alumina	4.83
Peroxide of iron	8.90
Oxide of copper	27.97
Water	20.00
	99.55

contains 22.33 per cent. of metallic copper. Another sample yielded per cent. of silicic acid and 23 per cent. of oxide of copper. A third, poorer, yielded 16.8 per cent. of copper. A fourth sample was taken n average of the ore raised in mining, after being properly dressed for furnace, and by assay in the crucible it yielded, on 500 grains of the 50.4 grains copper, or 10 per cent., which is the amount of copper that be obtained by smelting the picked copper ore.

Assay of black oxide of copper from Copper Harbor.

specimen of this ore yielded on 100 grains—

Silica	11.2
Oxide of iron	2.0
Oxide of copper 80.0, which contains 63.86 metallic copper.	
	93.2

he loss in this assay is supposed to have been from water in the hy- is silicate of copper mixed with the black oxide.

ermination of the water in prehnite from the surface of a mass of native copper.

he native copper of the Cliff mine was observed to bear very distinct ressions of crystals of prehnite, and it becomes a matter of interest to

know whether the crust of prehnite adherent to its surface was anhydrous or not, for if molten copper had been brought in contact with it we should expect that the fusible and hydrous zeolite, if not fused, would at least be deprived of its water of composition. I therefore detached a crust of crystallized prehnite, which had impressed the surface of the copper, from a mass of the copper, and having dried it at 212°, weighed it, and then exposed it to a temperature of dull redness in a covered platinum crucible. It lost by heat 4.4 per cent. of water, and is therefore as hydrous as that mineral generally is; for, by comparing the water found in this species by other chemists, we found it to be, in 4 analyses: 1st, 4.18; 2d, 4.45; 3d, 4.50; 4th, 4.41. The mean of these 4 analyses is 4.33. It is obvious, therefore, that the prehnite from the Cliff mine has not been exposed to a high temperature since it was deposited in the vein, and hence the metallic copper impressed by its crystals could not have been in a molten state when it took the impressions of those crystals. I arrived at the opinion also, by observing the impressions of prehnite on the copper of the Lake Superior Company's mine, that the copper could not have been deposited upon it in a molten state. This opinion has been sustained by other observations.

Chemical analysis of apophyllite from the masses of native copper extracted from the vein at the Cliff, on Eagle river.

The determination of this mineral species was also regarded as highly important to the theory of the origin of native copper veins, for this very hydrous mineral was found imbedded in a mass of native copper a foot in thickness, and was closely adherent to the metal. Perfect crystals of this mineral were carefully picked from the surface of the copper, and were submitted to analysis. Their specific gravity was found to be 2.395. The crystals are in the form of right square prisms, with their edges and solid angles replaced by planes. Analysis of 2 grammes of this mineral gave—

	1st analysis.	2d analysis.
Silicic acid	52.700	51.000
Lime	23.350	24.944
Fluoride of calcium	1.850	1.940
Potash	4.950	5.187
Water	16.000	16.000
	98.850	99.071

This mineral is therefore apophyllite, and contains the usual proportion of water.

Chemical analysis of black calc spar.

A curious variety of calcareous spar occurs at the openings made by the New York Copper Company at Agate Harbor. It is perfect, crystallized in regular six-sided prisms, with three and six-sided summits, and is of a uniform jet black color throughout. In order to determine the nature of this coloring matter, I dissolved the carbonate of lime in dilute chlorohydric acid, which left the black matter insoluble. On testing this it was found to be black sulphuret of copper, and amounted to

28 $\frac{4}{10}$ per cent. of the weight of the calcareous spar. Another crystal analyzed yielded 17 $\frac{4}{10}$ per cent. of oxide of copper, or 13.38 metallic copper. The copper was in the state of black sulphuret in the crystals, and was uniformly mixed with the carbonate of lime.

Sulphate of baryta also occurs in great abundance at this mine, and is colored jet black by admixture of black sulphuret of copper. A specimen analyzed yielded 5.19 per cent. of metallic copper.

Black sulphuret of copper from Eagle Harbor mines.

Sulphuret of copper occurs also at the Eagle Harbor mines, and forms a crust on some of the veinstone containing native copper. This mineral having been mistaken by others for pulverulent black oxide of copper or "*copper-smut*," I analyzed it, and found it to be a pure black sulphuret of copper.

Chemical analysis of red analcime from the Copper Falls mine.

This mineral is found associated with calcareous spar and leonhardite in the copper vein, and is a curious variety, remarkable for its departure from the regular form of analcime. It was at first supposed to be a pseudomorphous mineral; but my analysis seems to indicate that it is a mixture of analcime with leonhardite, and it probably derives its crystalline form from the latter mineral. It occurs in rhombic prisms an inch in length, terminated by the usual planes of trapezohedral analcime. It has a fine flesh or salmon-red color, and is sometimes of a much deeper color at the terminus of the crystals. Its specific gravity is from 2.250 to 2.258. Its hardness is a little below that of crystallized and transparent analcime. Before the blowpipe it whitens, exfoliates a little, and then melts into a clear, colorless glass, with some bubbles. It colors the flame of the blowpipe lamp-yellow, indicating the presence of soda. By chemical analysis, I found it to consist of—

Silicic acid	53.40
Alumina	22.40
Lime	3.00
Soda	8.52
Water	10.31
	97.63

Chemical analysis of the water from the middle of Lake Superior.

One imperial English pint of the water of Lake Superior gave, by evaporation, 0.008 grain of solid matter, of which 0.003 was vegetable matter and 0.005 mineral matter. The mineral matters were carbonate of lime, carbonate of magnesia, peroxide of iron, oxide of maganese, and sulphate of lime. The gaseous matter dissolved in this water was ascertained to be 3.23 per cent. of its bulk. The gases are atmospheric air and carbonic acid gas. From this analysis it is evident that the water of the great lake is remarkably pure. It derives the small proportion of organic matter in it from the tributary streams which run through

bogs and swamps, and empty into the lake at various points. Living aquatic plants on the borders of the lake, in sheltered harbors, were observed to give off oxygen gas abundantly, so as to saturate the water with it and to rise in bubbles to the surface. This can be observed whenever the sun shines on the subaqueous plants. Fishes, it is well known, require oxygen dissolved in water to support their respiration, and they produce by their respiration carbonic acid gas, which is consumed by plants. It is probable, therefore, that the water near growing aquatic plants will contain a larger proportion of dissolved oxygen. By agitation of the surface of the lake by winds, air is also enveloped and dissolved in the water.

Assay of a rich sample of silver and copper ore from Copper Falls mine.

This sample was taken from near the junction of the trap rocks and sandstone, and consists of a mixture of metallic silver and copper in a green mineral, which usually accompanies the silver of these veins. On working this sample, I took 46,530 grains of the pulverized, and washed the earthy matter out, leaving 7,440 grains of silver and copper. The fine ore washed gave 3,670 grains of a mixture of fine metallic particles and rock. The whole of the washed metals and ore weighed 8,350 grains, and on fusion gave 4,770 grains of metal, which yielded 51.38 per cent. of pure silver and 48.62 per cent. of copper. The whole amount of silver obtained from this ingot was 2,450 grains. The copper picked out in large pieces, added to that obtained by analysis, was 4,920 grains. The per centage yield of this ore was 10½ per cent. of copper and $5\frac{38}{100}$ per cent of silver. This sample is far above the general average of silver ore. Some, that more nearly represents that portion of the vein, yielded from 1 to 1½ per cent. of silver.

Experiments on the separation of silver from the sulphuret of zinc of the Prince vein on the north shore of Lake Superior.

I wished to ascertain how perfectly the process of amalgation would separate the fine native silver from the blende, and on three separate trials on the same sample, obtained from 200 grains of the washed ore, 1st, 14 grains; 2d, 16 grains; and 3d, 16 grains. I then took 400 grains of the same ore, roasted it to convert the sulphuret of zinc into oxide of zinc, and then, by adding a reducing flux, I converted the oxide of zinc into metallic zinc, which volatilized, and the silver was obtained in a button. It weighed 24 grains, or 6 per cent., or 12 grains on 200. Another experiment gave, by the same method as last mentioned, $13\frac{63}{100}$ silver on 200 grains of ore. It is evident, therefore, that we need not have recourse to amalgamation in separating silver from blende, for it is easy to drive off the zinc by this process, and obtain the silver by the furnace operations alone. This will be a great saving of expense in working that ore. A larger sample, weighing 1,260 grains, was treated by the same furnace operations, and the zinc being sublimed, there remained after refining, 118 grains of metallic silver.

periments on the washed ore obtained from the mills of the Lake Superior Company, Eagle river.

This ore was stamped and washed from the last ore raised from the ne before closing operations. I was not able to learn the amount of k that had been stamped, or the per centage yield of this work, the nt having left the mines. The richness of this poorly-washed ore sured me, for I found that 5,000 grains of it washed to 2,400 grains, and ed with soda, borax, and lime, yielded an alloy of copper and silver ghing 1,210 grains; and on analyzing 365 grains of the ingot, it yielded 73 grains of silver, or nearly 29 lbs. per ton. 10,000 grains of the ore, rewashed, were mixed with an appropriate flux and melted. The ton obtained weighed 3,045 grains; 219$\frac{8}{10}$ grains of this button anaed gave 3.84 grains of silver, or 53.30 on the whole; or 34$\frac{1}{4}$ lbs. per of the metal. So large a portion of silver as is contained in the metals his mine ought not to be allowed to pass with the copper, but should eparated from it by eliquation or by sulphuric acid, in case the sulte of copper produced can be sold advantageously.

Analysis of copper pyrites from the Bruce mine, St. Mary's river.

100 grains of the ore yielded—

Copper - - - -	23.000
Iron - - - -	25.376
Sulphur - - - -	24.024
Quartz - - - -	27.600
	100.000

The regulus obtained from the roasting heap yielded 34$\frac{8}{10}$ per cent. of per, and is pure copper pyrites free from rock.

ays of samples of gray copper ore from the stock-werke lode of the Suffolk Company's mines.

ample No. 1 was from a vein of clean gray ore. It yielded 59 per t. of copper.
ample No. 2. Trap rock encrusted with carbonate of copper, and coning gray ore. This yields 8.6 per cent. of copper.
ample No. 3. Similar to No. 2; yielded 6.6 of copper.
ample No. 4. Gray ore mixed with the rock. This ore yielded 8.5 cent. of copper. These were average samples of the ore first raised. The ore is somewhat richer lower down, but still too poor to be worked antageously on Lake Superior, in the present state of the country; for ough there is a large bed of the ore-bearing rock, no regular vein exists re, and it is not worth the expense to erect stamping and washing maery when the vein is not certain.

mical analysis of copper and silver ore of the Lake Superior Company's mines, Eagle river.

ifteen hundred grains of the rock broken and pounded in a mortar, sifted; the large pieces of metal weighed 198 grains. The sifted fine

ore weighed 1,270 grains. This was washed, and 680 grains of wash metals was obtained. Dissolved these metals in pure nitric acid, t then precipitated the silver by chlorohydric acid, and reduced the res ing chloride to metallic silver by fusion with carbonate of potash. T silver weighed 117.75 grains. This ore is principally valuable for silver it contains.

Chemical analysis of washed metals from the mills of the Lake Sup Company, Eagle river.

1,000 grains of these metals yielded—

Copper - - - -	918.5
Silver - - - -	40.0
Rock - - - -	41.5
	1,000.0

Another sample yielded in 1,000 grains of the ore—

Copper - - - -	550.22
Silver - - - -	67.78
Rock - - - -	382.00
	1,000.00

One pound of the fine-sifted metals yielded 269¼ grains of silver.

Assay of 20,000 grains of the fine-washed metals from the 2d jig, I Superior Copper Company, Eagle river.

This metal yielded 470 grains of silver, or 2.35 per cent.

Another sample yielded in 1,000 grains of the washed metals—

Copper - - - -	927
Silver - - - -	23
Rock - - - -	50
	1,000

Another from the same locality yielded—

Copper - - - -	904
Silver - - - -	28
Rock - - - -	68
	1,000

Another sample of the coarse metals from the jigs yielded in 1,000 g

Copper - - - -	922.04
Silver - - - -	37.96
Rock - - - -	40.00
	1,000.00

The first metals separated by the kieve yielded in 1,000 grains—

Copper - - - -	957.8
Silver - - - -	6.7
Rock - - - -	35.5
	1,000.0

Working of a sample of the veinstone blasted from the Cliff mine, on Eagle river, at commencement of mining operations.

This sample was obtained from a heap of two or three tons of the ore, and represents the proportions of metal in the vein at the surface.

The sample weighed 77,437 grains, or eleven pounds one ounce. This was washed to smaller bulk, and

The coarse washings weighed	3,158	grains, or	0	pounds	7½	ounces.
The fine " "	2,075	"	0	"	4¼	"
The fine waste "	7,000	"	1	"	0	"
The coarse " "	21,437	"	3	"	1	"

From these materials I obtained from coarse-washed metals 1,284 grains.

fine " "	1,200	"
fine waste	313	"
coarse " worked over,	1,278	"
	4,075	"

The fine-washed ore gave - - -	silver,	2,005 "
The coarse workings gave - - - -	"	1,650 "
Amount of silver in 11$\frac{1}{16}$ pounds of the ore - -		3,655 "

The copper amounts to 105¼ pounds per ton of rock, or 5.26 pounds per cent.

The silver amounts to 663.64 grains per ton of rock, or 33.18 grains per cent.

Experiments on the economical separation of silver from copper by means of acids and by lead.

Having some samples of the washed metals from the Lake Superior Company's mine, on Eagle river, I made some experiments on the separation of the silver from the copper by the process of eliquation and cupellation. Two hundred grains of the washed metals, consisting of fine particles of silver mixed with copper and some trap rock, were melted with 100 grains of lead; and the whole being fused and cast into a cake, was submitted to eliquation, the cake being placed in a crucible with a hole perforated in the bottom, and this crucible being set into the mouth of another, and heat applied to the upper crucible until it was heated to dull redness. By this means the lead and silver, which alloy together, melt and run out from the copper, and this alloy is caught in the lower crucible, while the copper remains as a spongy mass in the upper crucible. On cupellation of the alloy of lead and silver, 58 grains of pure silver was obtained, and nearly all the copper was obtained by refining the spongy

mass that remained. I tried the experiment of determining how much nitric acid was required for separation of the metals by acids. One pound of the fine-washed metals required 2 pounds 5 ounces of strong nitric acid for solution of the metals. The silver being separated by chlorohydric acid as a chloride, and then reduced by fusion with carbonate of potash, amounted to 140 grains. The copper in solution was 6,340 grains, and the rock and oxide of iron amounted to 520 grains. It is evident, therefore, that the silver cannot be economically separated from the copper by nitric and chlorohydric acids.

Separation of copper and silver by means of sulphuric acid.

This experiment was made for economical purposes—to determine the expense of separation of the metals by conversion of the copper into a sulphate, to be sold as such, and to separate the silver in a metallic state. One pound of the fine-washed metals of Eagle river was roasted in a muffle until a scale of black oxide of copper was formed, and then the oxide was dissolved off by means of hot dilute sulphuric acid; the metal was then returned to the muffle, and the process repeated until all the copper was oxidated and dissolved and the silver was left undissolved. This silver, being removed and dissolved in nitric acid, precipitated by chlorohydric acid and reduced by fusion with carbonate of potash, amounted to 98 grains. The sulphate of copper crystallized weighed 3¼ pounds. On weighing the acid employed in the operation, it was found that two pounds of concentrated sulphuric acid had been consumed. This method can be practised economically, provided the sulphate of copper produced can be sold. There was a loss of silver in these operations, but that loss in works where large quantities of the metal would be roasted in ovens made for the purpose. The conclusion to which I have arrived, after a long series of experiments, is, that for the poorer argentiferous copper we must use lead and the eliquation process; but if the metals are rich in silver, sulphuric acid may be employed. I have worked upon this matter for three years, and have tried every method known for separation of the copper and silver, and have decided that it will be most economical to make use of lead, and, if possible, of argentiferous lead, so as to obtain the silver from both copper and lead by one set of operations. The lead may be melted with one lot of copper, then be run off by liquation and be remelted with another lot of copper; and so, by numerous repetitions of this process, the lead may be charged with a large amount of silver, so as to prove more valuable on cupellation. There is but 6 per cent. of loss of lead when this operation is carried on in the large way; for the litharge, being blown over, is mostly saved, and may be reduced to lead and used over again. In Germany litharge is used by fusion of it with roasted sulphuret of copper and silver, and a liquation cake is obtained and submitted to eliquation in proper furnaces, and the lead is separated from the silver by cupellation as above mentioned. The scoriaceous sulphuret of copper remaining is then refined and the copper is obtained. No works have yet been erected in the United States for effecting these operations, which might be profitably carried on if the washed metals of the copper mines on Lake Superior could be obtained.

Analyses of minerals supposed to be new species and varieties.

While making my first examinations of the copper vein at the Cliff mine on the SW. branch of Eagle river, in 1845, I discovered a mineral which was at first supposed to be a variety of nephrite, and with it an anhydrous variety of prehnite. I gave specimens of the minerals to Mr. J. D. Whitney, jr., who has analyzed them and published his results in the Journal of the Boston Society of Natural History, volume 5, page 486 *et seq.* The following is his description of the compact wollastonite, or table spar—the mineral so much resembling nephrite, that it was a matter of surprise to both of us that it should prove to be of the same chemical composition as wollastonite. This mineral Mr. Whitney analyzed in Berlin.

"The wollastonite which is found on Lake Superior differs considerably in external characters from any known variety of that mineral. Indeed, its true character could only be recognised by chemical examination. It is remarkable for its excessive toughness, which quality it seems to possess in a higher degree than any known mineral. It is compact, with an uneven fracture. Its color is light flesh red; hardness, 6; lustre, vitreous to pearly. It is readily decomposed by acids, the silica separating in the form of a flocky precipitate. The analysis of two specimens gave the following results:

	First.	Second.
Silica	49.09	49.06
Lime	46.38	44.87
Protoxide of manganese	.48	.93
Alumina	.23	1.28
Magnesia	.14	
Carbonic acid and loss	.72	.90
Water	2.96	2.96
	100.00	100.00

"The mineral is, therefore, essentially a silicate of lime in which the oxygen of the silicic acid is double that of the lime; the formula is, therefore, $\dot{C}a^3\ \ddot{S}i^2$, or that of common table spar. The amount of water in this mineral, dried to 100° C., was found by two determinations to be 2.92 and 2.96 per cent.; still the quantity seems too small to allow it to be considered as forming an essential part of the mineral, especially as it retains all its properties unchanged after ignition."

While on the geological survey of Isle Royale, I discovered another locality of this beautiful mineral at a place called Scovill's Point, where it occurs in large masses in the trap rocks on the coast, and is associated with the anhydrous prehnite. I gave Mr. Whitney specimens of the anhydrous prehnite from this locality, and he analyzed it in my laboratory, and has published his results in the Journal of the Boston Society of Natural History.—(See volume 5, page 487.)

Mr. Whitney names this mineral "Jacksonite," in token of respect for my mineralogical services on Lake Superior; but I must decline the honor, being opposed to naming minerals after persons, and agreeing with the views published by the American Association of Geologists and Naturalists, that the names of persons should not be given to objects of natural history.

I shall, therefore, name it "anhydrous prehnite," as a name which its composition justifies. "This mineral occurs in finely radiated and lamellar radiated masses of a white color, slightly tinged with green. Its hardness is 6; specific gravity, 2.881; lustre vitreous, translucent. The finely pulverized mineral is perfectly, though slowly, dissolved by chlorohydric acid, the silica separating in the form of a flocky powder. Before the blowpipe in the platina forceps, it fuses very readily with strong intumescence, and emits a brilliant yellow light. A large quantity of soda dissolves it readily; if more of the assay be added, it swells up into an infusible slag. It gives with borax a colorless, transparent glass; with salt of phosphorus, a glass enclosing a silicious skeleton, and faintly tinged by iron."

The analysis of the mineral gave—

		Oxygen.	Ratio.	Calculated.
Silica - - -	46.12	23.96	3	46.17
Alumina and a little $\dddot{F}e$ -	25.91	12.09	$1\frac{1}{2}$	25.68
Lime - - -	27.03	7.90	1	28.14
Soda - - -	.85			
	99.91			

The oxygen of the silica, alumina, and lime being as 3 : $1\frac{1}{2}$: 1, or 6 : 3 : 2, the formula will be $\dot{C}a^3\ \ddot{S}i + \ddot{A}l\ \ddot{S}i$. This, it will be perceived, is the formula given by Walmstedt for prehnite, except that it contains no water. This mineral, "dried at 100° C., was found to contain less than $\frac{1}{10}$ per cent. of water."

Chlorastrolite.

This mineral was found on the shores of one of the islands in Rock Harbor, by John H. Blake, esq., while in the employ of the Ohio and Isle Royale Mining Company. Mr. Blake informed us of the locality, and I sent a party of my sub-agents to collect specimens of it; and, after making an examination with the blowpipe, I discovered it to be a new species, and gave it the above name, in allusion to its green color and the stellated grouping of its fibres. On my return to Boston, I employed my assistant, Mr. J. D. Whitney, to make a proportional analysis of it, which he effected, and has published the analysis in the Journal of the Boston Society of Natural History, volume 5, pages 488–9:

"The chlorastrolite occurs in finely radiated, stellated masses, with a pearly lustre, and slightly chatoyant on the rounded sides. Hardness, 5.5 to 6; specific gravity, 3.180; color, light blueish green. In the open tube it gives off water and becomes white. Before the blowpipe, it fuses with great facility to a greenish blebby glass. It intumesces and swells up like a zeolite. Soda dissolves it in small quantity, and gives a bead, colored by a trace of manganese; if more of the assay be added, it swells up into an infusible slag. It is dissolved by borax readily, and in considerable quantity to a transparent glass, colored by iron. Salt of phosphorus dissolves it in small quantity, and gives the reaction of iron. With nitrate of cobalt, it gives a beautiful blue. It is readily dissolved

ohydric acid, and the silica being entirely separated in the form ky precipitate. The analysis gave—

		Oxygen.	Ratio.
- - - -	36.99	19.22	3.00
ina - - - -	25.49	13.90	2.10
ide of iron and a little Fe -	6.48		
- - - -	19.90	6.50	1.01
- - - -	3.70		
h - - - -	.40		
r - - - -	7.22	6.40	1.00
	100.18		

atio of the oxygen $\dot{H}$ $\dot{R}$ $\ddot{R}$ and $\ddot{S}i$ being 1 : 1 : 2 : 3, the formula –

$$\left.\begin{matrix}\dot{C}a^{3}\\ \dot{N}a^{3}\end{matrix}\right\}\ddot{S}i + 2\,\ddot{A}l\left\{\begin{matrix}\\ \ddot{F}e\end{matrix}\right.\ddot{S}i + 3\,\dot{H}.$$

s formula would be that of meionite, with the addition of three water. A small portion of iron exists in the mineral as protoxide,

he analysis gives a slight excess of the bases $\ddot{R}$.
is mineral was named by Dr. Jackson in allusion to its peculiar structure and greenish color. It receives a fine polish, and form beautiful ornaments for setting in jewelry, could it be found tity sufficient for that purpose."
not think it can be employed as an ornamental stone, for it is not ough to receive a fine polish, and its color is too undecided to t attractive. This mineral was analyzed in my laboratory.

tion and analysis of black oxide of copper from the vein near Fort Wilkins, Copper Harbor.

ng the winter of 1848, I employed Mr. J. D. Whitney, my assist- the analysis of a pure sub-crystalline specimen of the black oxide er, which I obtained from the mine in 1845. He found it to con- t 1.2 per cent. of silicious matter, with traces of lime and oxide of This specimen yielded 98.8 per cent. of pure black oxide of which contains 78.868 of copper and 19.931 of oxygen. Mr. y's analysis gave—

Copper - - -	79.86
Oxygen - - -	20.13

A. A. Hayes and Mr. J. E. Teschemacher found some crystals of ck oxide in the masses of ore brought from this mine to the Rox- hemical works, which Mr. W. has thus described, (Proceedings Society of Natural History, p. 103:)

bstance tesseral, crystallized in cubes, with their solid angles l. Hardness 3; specific gravity 6.25; color steel gray to black;

lustre metallic. The earthy varieties acquire a metallic lustre on being scratched or cut with a knife."

The massive ore is frequently mixed with particles of green hydrous silicate of copper scattered through the black oxide. Purer specimens are lamellar oxide of copper, with the crystalline folia interlacing or aggregated irregularly.

The Copper Harbor vein is the only one of solid black oxide of copper known. Pulverulent black oxide is "copper smut," and is of frequent occurrence in other mines; and crystals of oxide of copper, resembling in appearance specular iron ore, are found in Mount Vesuvius, filling cavities in lava, and encrusting the old lavas of Mount Somma.

Analysis of a black mineral found by Mr. Barnes in township 58, *range* 28, *sections* 12 *and* 13.

This mineral, along with felspar, in large aggregated crystals, was found to compose the north side of a hill in the above locality. The rock contains, in addition to the above ingredients, magnetic iron and titanic acid. The best crystals were carefully picked out; and the magnetic portion, after being coarsely powdered, was separated. The mineral thus freed from impurities was analyzed by Mr. R. Cropley, and consisted, in 100 grains, of—

Silicic acid	51.28
Alumina	17.12
Protoxide of iron	3.90
Protoxide of manganese	.99
Lime	19.55
Magnesia	7.33
	100.17

From the above composition, it is evident that this mineral is pyroxene. Its specific gravity was found to be 3.478; hardness 5.5; lustre splendent; color brownish black; streak gray. Before the blowpipe alone, fuses to a black glass. With soda, it gives the reaction for manganese.

Specific gravity of trap rocks from Keweenaw point.

	Specific gravity.	Weight of one cubic foot in pounds.
e black trap from Copper Harbor -	2.743	$171\frac{4}{16}$
daloidal trap from near Porter's island, Harbor - - - - -	2.743	$171\frac{4}{16}$
gdaloidal trap from the extremity of aw point - - - - -	2.702	$168\frac{8}{16}$
gdaloidal trap from Eagle Harbor -	2.743	$171\frac{4}{16}$
ic trap, with crystals of red felspar, pper Rock Company's location on the ide of the trappean belt of Keweenaw - - - - - -	2.751	172
hyry of the Lac la Belle mines, Bohe- nountain, Keweenaw point, sub-crys- - - - - - -	2.631	$164\frac{4}{16}$
idal trap, containing about 8 per cent. allic copper, from Lake Superior Co.'s - - - - - -	3.0925	$193\frac{1}{4}$
ample gave - - - - -	3.1120	$193\frac{8}{16}$
red jaspery rock, supposed to be a rphie sandstone, from near Lac la Mount Houghton - - - -	2.572	$160\frac{7}{16}$
epidote, containing fine spiculæ of cop- ted with it, from Isle Royale, contains er cent. of metallic copper - -	4.854	$303\frac{8}{16}$

SOILS.

ter and chemical composition of the soils on Keweenaw point.

obvious, from the nature of the forests on Keweenaw point, that on the trap rocks differed essentially from those on the sandstone, where the soils were unmixed by drift agencies. Hard wood es, with large scattering pines, and a comparatively open growth, ize the trappean soils; while spruce, arbor-vitæ, tamarack, and fir und more on the sandstone soils, and are more dwarfish and

A difference of level, in a great measure, determines the char- those soils in part. The sandstone, being generally lower, is mpy. But, even where the two rocks are on the same level, the ance of hard wood trees characterizes sufficiently the trap ranges, s the surveyors to designate their position with a considerable de- ccuracy; while their more exact lines of contact are still better by the magnetic needle, the trap rocks being more highly mag- d even polarized, at their lines of contact with the sandstone. m alone would not be a sufficient guide, for the trap is also polar-

ized at its disjunctions, where seams of veins divide its masses. Hence we have also to regard the native forests as additional evidence. In a country where the snow falls as soon as the deciduous trees begin to shed their foliage, there is less decomposition of the dead leaves than in warmer climates, and a heavy mantle of foliage accumulates in the forests. This also seems to modify the soil, by preventing the ready access of air to the organic matters. Therefore, the unveltilated soils are different from those which have been cultivated, and the acid matters produced by decay of a superabundant covering of dead leaves render new soils less fertile than they would become after a few years tillage. Hence the first attempts at cultivation of the soils of Keweenaw point did not give very favorable results; but further experience has proved that the soils, especially those of trappean origin, are warm, sweet, and fertile, producing all the usual culinary vegetables of northern climates luxuriantly.

The ashes produced by burning the forest trees neutralizes the acidity of the soil; and where this fertilizing agent is spread on the soil, it invariably renders it extremely good, so that large and thrifty plants spring up upon it, and wheat, barley, oats, and English grapes, and especially herd's-grass, grow admirably. Potatoes are the most valuable produce of new lands in that country, and this crop prepares the land for other crops which could not be advantageously grown upon it at first. Oats, for instance, grow too rank, and do not fill well, on the new soil, but thrive well after a few crops of potatoes have been raised. The same will be found to be the case with wheat and barley, which have not yet been raised there, excepting by the accidental scatterings of some of the grains. Winter wheat will, I doubt not, be ultimately raised in this soil; and spring wheat, I know, will do well on cultivated land. Root crops invariably succeed in all parts of that district.

Although I attach but little importance to chemical analyses of soils taken in the forest, knowing how much they will change in character by cultivation, I thought it might prove interesting to analyze a well-characterized specimen of soil from the two great rock formations on the point; and I therefore selected those which were perfectly characteristic, and which had been tilled and rendered somewhat uniform by admixture of their particles. One of the samples selected for analysis was taken from a pure sandstone soil at Mr. Meneclier's garden at L'Anse, near the head of Keweenaw bay. This soil has been cultivated for some time, and is tolerably fertile, producing the usual culinary vegetables. The analysis was made by Mr. R. Cropley.

5,056 grains of this soil, sifted in the usual manner for determining the degrees of fineness of the ingredients, gave, by this mechanical separation—

Fine gravel	196	grains.
Fine loam	4,860	"
	5,056	"

hemical analysis of 100 grains of the fine loam gave—

Water	.73
Organic matter	2.92
Insoluble silicates and silex	94.24
Peroxide of iron and manganese	.92
Alumina	.47
Carbonate of lime	.32
Carbonate of magnesia	.07
Sulphates of alkalies	.06
	99.73

selected a good and well-characterized specimen of trap soil from the syth location, township 57, range 32, section 33, in the middle of Kenaw point—the soil having been cultivated for three seasons, but not ured.

his soil was analyzed by Mr. R. Cropley in my laboratory, and yielded, nechanical separation—

Coarse gravel, sticks, and stones	782 grains.
Finer gravel	570 "
Fine loam	2,196 "
	3,548 "

hemical analysis of 100 grains of the fine loam gave—

Water	2.79
Organic matter	8.93
Insoluble silicates and silex	81.10
Peroxide of iron and manganese	3.91
Alumina	2.61
Carbonate of lime	.46
Carbonate of magnesia	.25
Sulphates of alkalies	.22
	100.27

n the mechanical separation of the materials of the soil, it was first rated by a sieve of $\frac{1}{8}$-inch meshes, and what remained on the sieve coarse gravel. It was then sifted in a sieve with $\frac{1}{20}$-inch meshes, what remained on this was the fine gravel and sand. The fine loam ed through the second sieve, and was taken for analysis. The mical analyses were performed in the usual manner. It will be reked that the alkalies are in a great measure removed from the trap ts by decomposition and the action of vegetation. These soils are racteristic on the rocks, occurring on the rocks which I personally veyed, viz: Keweenaw point and Isle Royale. I was not furnished with ples of the soil surveyed by my assistants, and hence cannot represent r nature. Isle Royale possesses precisely the same kinds of soil that t on Keweenaw point; and the forest trees are as marked on the two

different rocks as they are on Keweenaw point, the trap soil being the most retentive and fertile.

It so happens that the trap rocks are the mineral-bearing portion of the country, and that they are also on the best agricultural land; hence reservation of the trappean lands would exclude the best agricultural lands from sale, and would oblige agriculturists who could not afford to pay the price of mineral lands to purchase on the poor sandstone districts, or to refrain from settling in that country.

The mining population will be the ready purchasers of agricultural produce, and it is desirable that farmers should settle near to their mines. The hope of finding a copper mine on their land would induce many settlers to purchase land on the trap ranges, when they would not choose to do so if they had no such expectations; for the climate is not so inviting as that of more southern States.

Temperature of Lakes Huron and Superior.

In the summer of 1844 I made a few observations on the temperature of these great lakes while passing over them, and while employed in the geological survey I have continued those researches. The following are the results obtained:

July 27, 1844.—Off Thunder bay, Lake Huron, the temperature of the air was 20° C., or 68° F. The temperature of the lake was 19° C., or 66¼° F.

August 2, 1844.—Temperature of St. Mary's river was 19¼° C., while the temperature of the air was 18° C.

August 8, 1844.—At noon, in latitude 47° 11′ N., the temperature of Lake Superior was 9° C., or 48.2° F.; the temperature of the air being 12° C., or 53$\frac{6}{10}$° F. A combing sea was the cause of this elevation of temperature in the water.

June 22, 1847.—At 3 p. m., the temperature of Lake Huron was 9° C., or 48.2° F.; while the temperature of the air was 15° C., or 59° F. The surface of the lake was tranquil. In the middle of Lake Huron the temperature of the water was 6° C., or 42.8° F.; that of the air being 9° C., or 48.2° F. Weather fine; moderate wind and but little sea.

June 25, 1847.—Lake Superior, off Grand island, had a temperature of 2½° C., or 36.5° F.; while that of the air was 9° C., or 48.2° F. Lake tranquil.

July 22, 1847.—Lake Superior, (north side,) off Pigeon river: Temperature of the water of the lake was 3¼° C., or 38.3° F.; while that of the air was 8° C., or 46.4° F. Nearer Pigeon river, the temperature of the lake was 5° C., or 41° F.; while that of the air was 9° C., or 48.2° F.

June 28, 1848.—Lake Huron, off Saginaw bay, at 8 a. m.: Temperature of lake, 55° F.; that of the air being 59° F. At 10 a. m.: temperature of lake, 56° F.; that of the air being 56° F.

July 7, 1848.—At 9 a. m.—Anchorage of St. Mary's river: Temperature of water, 55° F.; while that of the air was 66° F. Lake Superior, near Whitefish point: temperature of the lake, 55° F.

July 8, 1848.—Far out in Lake Superior, Keweenaw point being just seen in *mirage:* Temperature of the lake, 38° F.; that of the air being

47° F.; weather fine, lake tranquil. At 9 a. m.: temperature of lake, 39° F.; that of the air being 45° F.; weather still fine.

September 30, 1848.—Lake Superior, in latitude 47° 20¼′ N., longitude 86 W., at 8 a. m.: temperature of the water of the lake, 43° F.; that of the air being 44° F. The weather had been stormy; sea heavy, strong wind.

It is evident from these observations that Lake Superior has a very uniform temperature in its deepest parts, and that the temperature is nearly that of the maximum density of water. It must, therefore, have the same temperature at the bottom as at the surface. Although so near the freezing point in summer, the lake does congeal in winter, excepting near the shore where the water is shallow.

In making my first observations on the temperature of these lakes, I chose the most stormy days, when the wind made a combing sea, under the impression that the water would, by this agitation, give the lowest temperature of the lake; but, quite to my surprise, I found the water always warmer after a storm. This is owing to the contact of warmer air which is enveloped in every curl of the waves, and transmits to the water its heat. I found the water most uniformly cold in calm weather.

Observations for the determination of the latitudes of certain places on Lake Superior.

June 30, 1847.—Eagle river, Lake Superior Company's office, lat. 47° 23′ 28″.8—(Whitney's observation.)

July 10, 1847.—Lac la Belle mines, Bohemian mountain, Keweenaw point:

Merid. alt. of sun's upper limb, 130° 20′ 45″, t. 26° C., B. 29.20.
lower limb, 129° 18′ 15″.
Latitude calculated, 47° 21′ 55″.6.

July 19, 1847.—Base of Porcupine mountains, R. 43 W., T. 51 N., section 10:

Merid. alt. sun's L. L., 127° 37′ 50″, t. 16° C., B. 29.49.
Latitude calculated, 46° 49′ 2″.

July 20, 1847.—La Pointe American Fur Company's store, west end of Lake Superior:

Merid. alt. sun's L. L., 127° 21′ 15″, t. 26° C., B. 29.22.
Latitude calculated, 46° 46′ 25″.

August 1, 1847.—"Little Finger of Isle Royale," east end of the island:

Merid. alt. sun's L. L., 119° 16′ 45″.
Latitude calculated, 48° 10′ 25″.

August 5, 1847.—" Gull rocks," Isle Royale, in a small cove on Isle Royale:

Merid. alt. sun's L. L., 117° 29′ 45″; index error = — 15″.
Latitude calculated, 48° 1′ 22½″.

August 6, 1847.—" Hagamon's Cove," Isle Royale:

Merid. alt. sun's L. L., 117° 10′; index error = — 15″.
Latitude calculated, 47° 54′ 53½″.

August 7, 1847.—Phelps's island, Washington Harbor, Isle Royale:

Merid. alt. sun's L. L., 116° 45′ 45″.
Latitude calculated, 47° 50′ 35½″.

August 8, 1847.—Card's point, Washington Harbor, Isle Royale:
Merid. alt. sun's L. L., 116° 10′ 5″, t. 22° C., B. 29.6.
Latitude calculated, 47° 51′ 29″.

August 10, 1847.—Rainbow cove, southwest end of Isle Royale:
Merid. alt. sun's L. L., 115° 3′ 50″, t. 19° C., B. 29.57.
Latitude calculated, 47° 57′ 9¼″.

August 17, 1847.—Rock Harbor, camp opposite the entrance of the harbor:
Meridional altitude sun's L. L., 110° 18′ 45″.
Latitude calculated, 48° 04′ 40″.8.

August 18, 1847.—Meridional altitude sun's L. L., 109° 38′ 45″.
Latitude calculated, 48° 04′ 41″.1.

August 20, 1847.—Meridional altitude sun's U. L., 109° 24′ 00″.
Latitude calculated, 48° 04′ 35″.6.

August 21, 1847.—Meridional altitude sun's U. L., 108° 44′ 15″.
Latitude calculated, 48° 04′ 36″.9.

August 22, 1847.—Meridional altitude sun's U. L., 107° 00′ 45″.
Latitude calculated, 48° 04′ 38″.5.

August 23, 1847.—Meridional altitude sun's L. L., 106° 19′ 50″.
Latitude calculated, 48° 04′ 51″.7.

List of township sections which contain veins of copper and copper ores.

The geological map of Keweenaw point which accompanies this report represents the positions of all the mines which have been opened on Keweenaw point, and the limits of the metalliferous trap rocks. It is therefore unnecessary to detail in words what is better represented on the map, and I shall therefore only define the positions of the known copper veins, and designate the sections on which there is a probability of finding others, not warranting the certainty of finding valuable mines on them, but only pointing out the positions where they are most likely to be found, and on land sufficiently elevated for mining purposes.

I shall first designate sections known to contain veins of copper or copper ores.

nship.	Range.	Section.	Description of ore.
58	29	29	Gray sulphuret of copper.
58	29	32	Do
58	29	31	Do
58	30	34	Do
57	30	5	Do
58	30	15	Native copper and silver.
57	31	10	Gray sulphuret of copper.
57	31	16	Native copper and gray sulphuret.
57	31	19	Do do
58	31	19	Native copper and silver.
58	31	11	Do
58	31	12	Do
58	31	23	Do
58	31	24	Native copper.
58	31	30	Native copper and silver.
57	32	36	Do
57	32	1	Do
57	32	33	Do
56	32	7	Do
56	32	8	Do
55	34	26	Native copper.

nship sections which probably contain veins of copper and copper ores on the north side of the trap belt of Keweenaw point.

Township.	Range.	Section.
58	28	3, 4, 5, 6, and 9.
58	29	1, 2, 3, 11, and 12.
58	30	7, 8, 9, 10, 12, 13, 14, 16, 17, and 18.
58	31	12, 14, 15, 20, 21, and 22.

In this side of the trap range, native copper is generally found in reguveins, with prehnite. Sulphurets are very rare. The metalliferous is amygdaloidal trap.

On the south side of the trap belt.

Township.	Range.	Section.
58	28	20, 29, and 30.
58	29	22 and 23.
58	30	32, 33, 34, 35, and 36.
57	30	5 and 6.
57	31	1, 2, 3, and 9.
56	32	4, 8, 17, 19, and 36.
55	33	1, 11, 15, 21, 23, 25, 29, and 30.

In this side of the trap range, gray sulphuret of copper most frequently

occurs in porphyritic trap, either in a disseminated state in beds or in veins of calcareous spar. Native copper more rarely is found in narrow veins.

Township sections on Isle Royale in which veins of native copper have been found.

The metal occurs in trap rocks in true and imbedded veins, the former being generally narrow, and traversing the trap range at a considerable angle with its course, and having a high inclination; while the imbedded veins follow the course of the trap, and have a very moderate dip, compared with that of the sandstone rocks. None of the mines thus far opened have been sufficiently proved as to be regarded valuable for working, though some of them have yielded a considerable quantity of copper—enough to encourage deeper explorations.

Township.	Range.	Section.
67	32	35.
66	33	3 and 4.
66	34	13.
66	34	22, 23, 26, and 33.
65	34	10.
65	35	9, 10, 12, 16, 20, 21, 22, 27, 28, 33, and 34.
65	36	12, 17, 28, and 29.
65	37	23 and 24.
64	38	11 and 19.
63	39	10.

It is probable that veins of copper will be found along the line of junction of the trap and sandstone in ranges 35, 36, 37, and 38, and townships 63, 64, and 65. (See geological map of Isle Royale which accompanies this report.)

Respectfully submitted by your obedient servant,

CHARLES T. JACKSON,
United States Geologist, &c.

Instructions to George J. Dickenson, 2d Sub-agent.

PROPELLER INDEPENDENCE,
July 8, 1848.

SIR: You are hereby authorized to visit and explore Isle Royale for the purpose of ascertaining the nature of the rocks and minerals on each of the townships, and will request Mr. Ives, the linear surveyor, to furnish you with copies of the plats of townships he has surveyed, or you will ask the privilege of making copies of them yourself. Then, you will designate on those plats the places where you observe any rock, marking the spot by some sign on your plat, and referring to it in your notes.

You will, whenever you discover any copper vein, mark the trees around it and make notes of the spot in your memorandum book, and on the township plats. You will ascertain the line of junction of the sand-

stone and trap rocks, which is somewhere between Washington Harbor and Datholite Cove, fixing the direction of the line by marking on the township plats where the junction is, in the interior, along its whole course. You will make profiles of the sections of the island from coast to coast, representing the position of the rocks, marking the dip of sandstone and conglomerate, and noting every included bed of conglomerate or sandstone in the trap. You will also notice every depression corresponding with the usual course of the veins of copper on the island.

Since you have not instruments for measuring heights, you may make estimated sketches of the hills and valleys, noting the places of streams, ponds, swamps, &c., and put on the profile notes of the exact nature of the rocks, specimens of which you will obtain, mark, and preserve for my examination. The width of every vein must be noted at the time of measurement, and the course and dip, with remarks on the nature of the lode.

You will note every house or improvement, and ascertain who built the houses or made the improvements. You need not spend much time on the coast, as I have explored the whole circuit of the island. You need not spend much time in the examination of swamps, but limit yourself to the exploration of such ground as is suitable for mining operations; and you will mark the number and course of all the ridges of rocks, and mark their places on the plats of townships. Mr. Ives will doubtless give you copies of his plats; but if he should fail to do so, you may make out as good a plan as you can yourself, and find your positions by his marked trees.

After you have completed the explorations you are able to make, you will take passage to Copper Harbor in the first vessel going thither, and report yourself to me.

You will write to me concerning your progress as frequently as possible. In this survey you will be assisted by Mr. James McIntire, who will be associated with you.

Respectfully, your obedient servant,

C. T. JACKSON,
United States Geologist.

Mr. Dickenson's report.

BOSTON, *November* 10, 1848.

DEAR SIR: Complying with your instructions, I, in company with Mr. James McIntyre, after our arrival at Rock Harbor, Isle Royale, proceeded to visit different sections of the island. On July 11 left for Washington Harbor, where we found Mr. Ives and party, and obtained of him his plats of his work for this season, and took copies of them. Mr. Ives finds the west end of the island little better than the ground he ran over last year. He says the ridges are not quite so high and less abrupt in their formation, and the main ridge gradually disappears as he passed towards the west end of the island. The swamps are wider on this part of the island. The variation of the needle greatest west on trap, 18°, and from 20° to 30° east; the variation on the sandstone is from 2° to 20°, and increases as we approach the trap.

We ran in on section 1 till we came to line, and between section 1, T. 63 N., R. 39 W., and section 6, T. 63 N., R. 38 W., north of the quarter-

post, we found trap in place. From thence we went south to quarter-post between sections 7 and 12. Here, in the bottom of a brook, we found trap in place. A short distance south of this is found sandstone soil, filled with trap and granite boulders. The junction of trap and sandstone must be near this point; but, on account of the swampy nature of the ground, extending from the head of this bay to the head of Siskawit bay, all along on the line of junction, there are no indications by which the line of junction can be determined with accuracy.

We visited section 11, T. 63 N., R. 39 W. This is a sandstone formation. From this place we went to the ridge that forms the point that runs up into the centre of the harbor. This is a trap ridge, on the north side of which, on the shore of the bay, the trap is seen overlaying the conglomerate. After leaving the shore but little rock is exposed. This is on section 1, T. 63 N., R. 39 W. From this place we returned to our boat, and went to the northwest point of the island. Ran in on secs. 26, 25, and 24 of T. 64 N., R. 39 W., and saw but very little rock exposed.

July 19.—Left Washington Harbor for Siskawit bay; stopped on T. 63 N., and R. 38 W., and ran between sections 28 and 29, 20, 21, 16 and 17, to a perpendicular bluff of conglomerate 130 feet high, facing the north, at the foot of which is a small lake. I think this place presents one of the best views on the island.

At Siskawit bay we passed a small distance with our boat up a creek on section 24, T. 64 N., R. 37 W., where we found sandstone in place in the bottom of the stream. In passing up 30 yards further we found trap, over which the stream falls some 15 or 20 feet. Above these falls on the left, as we pass up the stream in section 23, is a conglomerate ridge. This place is the only one where the junction of sandstone and trap can be ascertained with certainty at the head of this bay. From this place we returned to Rock Harbor. We ran on a section line from the head of the harbor over McCargoe's inlet, and on this line we passed five small lakes. On the first portion of this line the ground is burnt over, and, as is generally the case on the burnt land of this island, the rock is left exposed, the timber falls and decays, making a soil for a new growth. There seems to be soil and moss enough on the whole surface of the island to cover up the rock, but the moss is mostly consumed when the soil is burnt over, leaving the rock bare. The rest of the soil on this line is covered with a thick growth. A description of each one of these lines seems to be useless, as the country for one mile is so like another, that to say it is partly covered with cedar swamp, or with spruce, fir, hackmatack, and thick undergrowth or windfalls, and plenty of trap rock, I think would answer for the whole island. It is my intention to make a copy of the plats, and mark the sections we have run over, and mark out the line of junction as near as possible of the sandstone and trap.

On our return from McCargoe's inlet we started again for Siskawit bay. Stopped at Lea's cove, and ran an east and west line to the head of Rock Harbor, passing on the line between sections 33, 34, and 35, T. 66 N., R. 34 W., and sections 2, 3, and 4, T. 65 N., R. 34 W. From Lea's cove we went to T. 64 N., R. 36 W., and taking the line between sections 9 and 10, passed to the north side of the island, between sections 3 and 4, T. 64 N., R. 36 W., and sections 33 and 34, 27 and 28, 21 and 22, 15 and 16, 9 and 10, T. 65 N., R. 36 W., then two miles east through sections 10 and 11 to McCulloch's location, in Todd Harbor.

Mr. McCulloch has nine men employed, and has at present the best prospects of any one on the island. He is working three different veins, two of which are but a very short distance from the vein he was working when you visited his mines last season. After drifting on that vein some 30 feet, all signs of copper disappeared. He then sunk a shaft a short distance north of this drift; and in sinking 5 or 6 feet, struck a blue earth filled with copper in the form of shot. This bed was 5 or 6 feet thick, and below this there was a red colored rock filled with spar, but it contained no copper. He left this, and is now drifting in on a vein on a level with the surface of the lake, so that a strong north wind carries the water into the drift. He has run about 60 feet in the whole, 30 feet of which is under ground; the veinstone is 2½ feet wide; the walls are well defined, and the vein dips 70° west. There is one sheet of copper exposed 8 feet long, 4 feet in height. How much further it extends down is not known. It is from 1 to 2 inches in thickness. They also were uncovering another sheet. West of this vein he is sinking a shaft, on a small spar vein, containing some copper. He has still another vein east of his house, which runs north and south. He sank a shaft on this vein so near the lake shore, as to oblige them to abandon it on account of the water, and sank a shaft further inland, and in sinking this he struck a small spar vein running east and west.

We left this place and passed back to the south side of the island, on line between sections 11 and 12, 13 and 14, 23 and 24, 25 and 26, 35 and 36, T. 65 N., R. 36 W. The junction of trap and sandstone is about a quarter of a mile from the lake shore, between sections 35 and 36.

We next went to the head of Siskawit bay, and taking an Indian trail, ran up to the maple ridge, passing through sections 28, 29, and 20. This maple growth is about 4 miles long and 30 chains wide. We went to the corners of sections 18 and 20, T. 64 N., R. 37 W. From here ran west two miles between sections 18 and 19, and sections 13 and 24, T. 64 N., R. 38 W.; then ran south two miles, between sections 23 and 24, 25 and 26; then four miles east between sections 25 and 36; then in T. 64 N., R. 37 W., between sections 30 and 31, 29 and 32, 28 and 33, to our boat.

August 11.—Left for Rock Harbor, there to wait for the propeller Independence. While waiting for her we visited Castle rock, and stopped at Scovill's point. There is one man left in charge of this place, and but little has been done since you visited it.

At Shaw's location there are three men employed in sinking on a shaft, which now reaches to the depth of 90 feet; and the indications are no better than when they first commenced. I think this is the same shaft you saw.

Mr. Whittlesey had six or seven men when we first arrived here, but since then all but two have left. He has sunk a shaft 40 feet, and drifted about 90 feet. He thinks he has 40 tons of 25 per cent. ore on hand.

The Isle Royale and Ohio Mining Company had a few men employed in sinking a shaft at Datholite, when we first came; the next boat brought a Mr. Mathews, a Cornish man, with a few hands, and he took charge of the works. This is the only place they are working at present. Mr. Mathews showed us some very good specimens of native copper, taken from the bottom of this shaft.

Mr. Douglas arrived here in the boat in which we left the island, with workmen to finish the construction of the copper furnace.

Mr. McCulloch's is the only location inhabited on the north side of the island.

The fishermen have left Siskawit bay, so that Datholite is the most western occupied place on the south side of the island; the most eastern inhabitants are at Scovill's point.

GEO. J. DICKENSON.

To Dr. C. T. JACKSON, *U. S. G.*

Mr. McIntyre's report.

SIR: In accordance with your request, I hereby give you a synopsis of my notes while engaged on the examination of Isle Royale, in Lake Superior.

On my arrival, with Mr. Dickenson, on the island, we immediately commenced a search for Mr. Ives, of the linear survey, who was then engaged on a survey of the island; and, as his plats would be beneficial to us, we wished to obtain them before commencing our researches.

We accordingly left Rock Harbor on the 11th of July, and coasted to the west end of the island, being informed that Mr. Ives was at or near Washington Harbor. The coast you have already examined; so a description of that would be unnecessary. On the second day after leaving Rock Harbor, we arrived at Washington Harbor—or, as the Indians call it, Sagauda, (deep hole)—and found a recent encampment of the surveyors. Here we concluded to remain until they sent out for provisions, which they probably would do in a few days. We were not disappointed; for on the next day Mr. Ives and his party arrived. They had a very hard time, and complained bitterly of the difficulties which they have had to encounter in getting through the woods. Mr. Ives very kindly furnished us with plats of the island, and gave us a good deal of general information in regard to the character of the country, which was very useful. After getting the plats, our first efforts were to ascertain the junction of the trap and sandstone. We accordingly entered the woods at the foot of the bay, and went in an east direction, following a creek for some distance up; but, finding it a continuous swamp, we were unable to find any place where the sandstone and trap actually met; but, from careful observation, we concluded it must be between section 12, township 63 north, range 39 west, and section 7, township 63 north, range 38 west, as we found trap on the north side of the line and sandstone on the south, within a short distance of each other. We also went into sections 11, 1, 12, 7, and 10, and our observations on these sections confirmed our views that the junction is as you will find it drawn on the map of the island.

After coasting east around the west end of the island, we entered the woods on a north and south line between sections 28 and 29, township 63 north, range 38 west, and went as far as section 16, to a bluff of conglomerate about 130 feet high, where we had the finest view that I have seen on the island. On the east of the bluff there is a beautiful lake, about two miles long, separated from the great lake by a narrow strip of low land. On the north is seen Washington Harbor, with its islands, and the high bluffs of the Canada shore in the distance. We could find no trap rock south of the bluff.

We then coasted as far as the foot of Siskowit bay, and encamped in a small bay near to it. The sandstone on the coast dips about eight degrees to the south, and is not so fine-grained as that of the pictured rocks on the south shore. Keweenaw point was visible several times during the day. In fact, it can be seen from the hills of this island on any clear day. About a mile from the lake we found the junction of trap and sandstone, in a creek. I went west from the creek about a mile, along an abrupt ridge of trap; and then went south a mile, through a cedar swamp, and came to sandstone on the south of the swamp: so the junction must be in this swamp. The trees, except those on the ridge, are mostly small spruce and cedar. There are some sugar maple and pine, with a few birch trees.

We then coasted east as far as Chippewa Harbor, which runs into the island about two miles, and is a very good harbor. On the southwest of the entrance, there is a precipice 150 feet high, which protects the harbor from any heavy wind.

Sunday, July 23, we coasted as far as Rock Harbor, and on the following day entered the woods from the foot of the harbor, which is about three miles from the entrance. We entered the woods on a north and south line; and, on going about a mile, we came to a ridge of trap about 100 feet high, and beyond it came to a small lake about a mile and a half long. These lakes are so surrounded with swamps, that it is almost impossible to get round them. We were therefore under the necessity of constructing a raft, which we did by lashing some logs together. We then paddled it across; and, after traversing the lake, we came to a high ridge of trap; and, after going about a mile further, we came to section-corner, range 34 west, township 66 north, section 29. Here we left the line and went east about a mile, to get round a small lake. We then took the next north and south line, and continued on it till we came to the north shore of the island, where we encamped. The character of the country we have passed through to-day is a fair sample of the island—it being swampy in the hollows, with trap ridges running nearly east and west, and interspersed with numerous small lakes. We passed no less than six lakes during the day.

Wednesday, we started on our return across the island, after finding the line that we had to follow near the lake which we had to cross yesterday. We then followed it as far as the lake. Here we left it, and went west for two miles, until we came to the township line, which we kept on till we struck a trail, about five miles from Rock Harbor, and arrived there at nine in the evening. The growth of wood on this section is mostly small cedar and spruce, with a few birches. The following are the ranges, townships, and sections, which we have been on during the day: Range 34 west, township 65 north, sections 5, 6; range 34 west, township 66 north, sections 35, 32, 28, 33; range 35 west, township 65 north, sections 1, 7.

August 4.—For the last few days, the wind has been so strong that it was impossible for us to coast until yesterday, when we got as far as Siskowit bay, and to-day went into the woods. We travelled on a north and south line, and, after going half a mile, came to section-corner, range 36 west, township 64 north, sections 3, 9. The country has been boggy, and rises gradually from the lake. Five minutes after leaving the corner, came to a ridge of sandstone, and immediately after saw a ridge of trap,

with a gradual slope towards the north. This is the point where the junction of the sandstone and trap occurs, in a swamp between the two ridges. The ridge of trap continued to slope until we came to the quarter-post. After leaving the quarter-post, we struck Siskowit lake, which we went round, and regained our line on the other side. After leaving Siskowit lake, the land is swampy, with a gradual rise towards the north. The growth has been mostly tamarack and small spruce, with a few cedar. The next section-corner from the lake is range 36 west, township 66 north, section 3, and range 36 west, township 65 north, section 34. After leaving the corner, we passed two small trap ridges; the land between being swampy, and covered with small cedar and spruce trees. We then came to the quarter-post; after leaving which, we came to a ridge of trap, which continued to rise till we came near the section-corner, when it began to slope again, and continued till we came to the corner, which is in a swamp, range 36 west, township 65 north, sections 33, 27. After leaving the corner, the ground began to ascend, the growth being mostly poplar, spruce, and pine. Shortly after passing the quarter-post, we crossed a creek running northeast. The growth after passing the creek was spruce and cedar, with some large birches. The ground continued to be swampy and rising gradually until we came to section-corner, range 36 west, township 65 north, sections 22, 28. Near this there is a good deal of spotted maple and small cedars—which, together with large ground hemlock, which reached nearly to our heads, makes it almost impossible to get along. In about ten minutes after leaving the corner, we came to the main ridge of the island, which I should think was about 400 feet high, and very much broken and precipitous on the north side. After descending the precipice, the descent was gradual till we came to the quarter-post, which is in a cedar swamp. Immediately after leaving the swamp, we came to a tamarack bog, and, after crossing it, we ascended a ridge of trap about 300 feet high. After descending the ridge, there is a cedar swamp, which continued until we came to the next corner, sections 5 and 21. After leaving the corner, we passed four small trap ridges, and then crossed a tamarack bog, with a creek on the north side of it. Running east, the next quarter post is near the creek. After passing two small ridges of trap, we came to a cedar swamp, where the section-corner is—sections 9, 15. After leaving the corner, we ascended for some distance, and then came to a steep descent of about 200 feet; after which, the decline was slight until we came to the quarter-post, which is in a tamarack bog. The growth for the last mile has been mostly tamarack, cedar, and spruce, with a few birches. Immediately after leaving the post, we came to a tamarack bog, with a creek running northeast. We then crossed three small trap ridges, the last one with a descent of about 100 feet. We then went on a level till we came near the lake shore, where there is a rugged descent of about sixty feet—range 36 west, township 65 north, section 10.

I have given you these details to show that the sections drawn on the map must be nearly correct, and could give details like these of all the ground which I have gone over; but, as the sectional drawings exhibit the formation at a glance, I concluded that it would be unnecessary to give the minutiæ.

After making this section across the island, we visited Mr. McCulloch's location, it being the only one in operation on the north shore of the island. There are two veins opened. The one at the lake shore is the

most promising. He has drifted in from the lake shore about sixty feet, and has got out some metallic copper. The character of the vein very much resembles those on the Ontonagon district, the copper being in thin sheets, and some distance apart. The vein runs NNE. and SSW., dipping 70° to the west. They are now sinking a shaft from the top of the hill, and it will strike near the end of the drift. After returning, we coasted to the foot of Siskowit bay, for the purpose of ascertaining the junction of sandstone and trap at that point. We entered the woods on an Indian trail running NNW.; and for the first mile we travelled over sandstone rocks. Gradually ascending from the lake, in a little more than a mile from it we came to a swamp, with a creek on the north side of it, running west. We afterwards ascertained that this stream is the same that empties into Washington harbor, and is called Mullet's creek. On the north of this creek the trap formation commences, so that the junction must be very near it. The forest consisted of large cedar and spruce, with some birch and sugar-maple trees. After going about a mile further, we came to the high ridge, where the growth is sugar-maple. The other trees are cut down, so that the maple will have the benefit of the sun. There is a good deal of maple, and sugar is made in this grove. The ridge is about 500 feet high, and is the highest point on the island. The lake can be seen on every side.

Yours, respectfully,

JAMES McINTYRE.

Dr. C. T. Jackson,
United States Geologist.

Report of George Orville Barnes, assistant sub-agent United States geological survey.

On our way to Lac la Belle we were detained at Horse-shoe Harbor by head winds, and I was detached to explore and examine the hills back of the harbor. I followed a section line one-fourth mile west of the harbor, and pursued it south. The quarter-post is near the lake; and at this point I saw trap rock, it being an extension of the belt at Copper Harbor. Proceeded south to some high hills of conglomerate on R. 28, T. 59, S. 35, near the town line, at which place I made a barometrical observation. This hill is one of the first objects seen on approaching Keweenaw point on the lake, it being part of a long range of high hills, extending from the easterly end of Lake Fanny Hooe nearly to the end of the point. The place measured by me, I think, is the highest of the whole range. This same range of conglomerate hills extends to Agate Harbor, with the exception of the break at Copper Harbor and Fanny Hooe lake. On returning to the boat, I measured all the important points on the section—the figures I shall give in the appendix. At Lac la Belle I took the elevation of the hill, and went with Messrs. Foster and Hill to the north side of the bluff, where some explorations had been made for a vein which was supposed to traverse the hills. The explorers had uncovered but little of the rock, and no satisfactory conclusions could be arrived at by a hasty view. They had run the course of the vein in the adit through the hill, and at different points on the bluff

they have prospected for the vein. The rock at the summit, and on the north side of the hill, is hard compact black trap. A chlorite rock seems to dip under the hill. Further down, near Lac la Belle, the conglomerate and sandstone appear. We examined the workings, and took specimens of ore and wall rock.

I proceeded to Copper Harbor (in the boat) on the 16th of July.

July 19.—Crossed Lake Fanny Hooe in boat, and took trail for Bost and Pittsburg Company's workings. Examined hill on which th have mined a little, by driving two drifts into the hill on a number small veins of quartz and prehnite, with a little copper. The veins disconnected, and branch out like a tree. The rock near the base of bluff is similar to that in same position at Lac la Belle, and change character three times before on the route to the summit, where it i compact crystalline trap. I made observation with barometer at ba the hill, and at the summit, to determine its elevation. Returning the north side of the hill, I found near the base, at a small brook, a l of pyroxine rock, which seemed to form the base of the whole ran hills. As far as I examined it, this rock gradually ran into black pact trap. I made a number of observations on my way back. next day I visited the same location, and examined the bluff south cabins, where I found the same rock as described yesterday, at the of a hill. The hill itself is composed of the same hard compact and is part of the same range as the one where they have been mi I saw trap 1¼ mile south from Copper Harbor, in place. The la this vicinity is very uneven. I ascended a high hill and descende cedar swamp below. The timber is mostly hemlock and cedar.

July 25.—I left Eagle river in company with Messrs. Foster an to measure a section across to Torch lake. We examined all the in our route, and I measured the most important points as far Forsyth Company's mine, when my barometer gave out, and I obliged to leave the section unfinished: the observations will be fo with others in the appendix. At Eagle river I followed the bed o river from the Lake Superior Company's mine to the lake, and eleven alternating belts of trap and sandstone. The sandstone tak course nearly southwest, and dips from 27° to 30° northwest. belts of sandstone vary in width from 10 to 150 feet. The first s stone, after leaving the breccia at the mine, is seen about 500 feet do the river from the third falls, and is 60 feet in width, and dips 32°. F ceeding down stream, I passed over amygdaloidal trap for 200 fe when I saw a belt of sandstone 10 feet in width, with the same dip a direction as the last; then 75 feet on another belt of sandstone 60 f wide; then compact trap 120 feet; and another belt of sandstone 40 f wide, dipping 30°; and so I proceeded to the mouth of Eagle river, af passing over 10 or 11 of these alternations. At the saw-mill I came conglomerate, which continues to the lake shore.

August 7.—I left Eagle Harbor with Mr. Hill, to measure section Lake Gratiot, and proceeded by way of the Copper Falls, Northweste Buffalo and Michigan Companies' mines, at all which places I took t elevations by the barometer, and examined the workings of the min and noticed at Copper Falls several alternations of trap and sandsto similar to those in the bed of Eagle river. Returning north, I travell along by the section line to Grand Marrais harbor. At the falls

Tobacco river, on section 12, range 31, township 57, I saw numerous alternations of trap and sandstone; the sandstone had a dip of 25°. Northwest of these falls I saw a sandstone belt of twenty or thirty feet wide, then a breccia and trap. The falls precipitate themselves over breccia, which continues for thirty rods below, where I saw variegated sandstone, which dips northwest 20°. The junction of sandstone and trap at this point can be laid down as being on northeast quarter of section 13, range 31, township 57. The junction of these rocks comes on north quarter of sections 15 and 16, one-third mile south of section line between 9 and 16. Examined the old workings of Copper Rock Company, which are on this section. The company worked a vein of calc spar in amygdaloid, with but little success. Returned to Eagle river by Suffolk Company's road. eft Copper Harbor and went south from Fanny Hooe lake, 1¼ mile, here I saw the trap rock; then took a southeast course to Massachusetts mpany's cabins, where I saw some rock as before described at the Pitts- g and Boston Company's mines, (as pyroxine.) This bluff is one of the e range of hills as that where the mine is opened, the rock occupying ame position as at that place. This company has worked a vein of nite in hard, compact trap. The veinstone contains small particles of e copper disseminated through it, but not sufficiently rich to warrant r expenditures; its width is from two to six inches, and its course 10° east on the surface. Made observations with the barometer at this and proceeded in a southeasterly direction to the cabins of the Bos- mpany, on south side of the point. I passed to-day through four ws, one of which was nearly half a mile long, and was covered a good crop of grass. At the point where these cabins are situated, I ed that the rock near the lake shore is very much disturbed, and re- es jasper or altered sandstone. It does not take the course of the trap but seems to follow the coast along in a southwesterly direction. leaving the cabins I went along the shore to examine the rocks. -thirds of a mile from the cabin I saw altered sandstone again, which nded one-third of a mile west, when we came to trap on southeast er of township 14. Three-fourths of a mile further along the coast w breccia. Near the cabins of the Massachusetts Company I saw a of altered sandstone which was fifteen feet wide, which is near to the workings of the Massachusetts Company. Where trap occurs on sec- n 35 I saw variegated sandstone. On the lake shore, jasper appears on ctions 26 and 27, near the fish-house at the point. On section 35 rphyry was seen for nearly one fourth of a mile, and it continues nearly Montreal river, where we saw trap again. The variegated sandstone seen near a small brook on section 27. I saw trap rocks extending from Montreal river to this brook, with the exception of a few masses of breccia. The trap has a red color, and is very amygdaloidal. Jasper comes in on section 25. I passed over jasper for nearly half a mile, when breccia appeared. From the cabins of the Clinton Company I returned to Copper Harbor, proceeding north on the section line, and taking observations at all the important points. I left Copper Harbor September 2, in a boat, with Dr. Jackson and Mr. Thayer, and three men, and arrived at L'Anse.

Friday, September 8.—I went with Mr. Whitney to examine the limestone in township 51, range 35, sections 13 and 14; took observations with barometer; returned to L'Anse, and gave the specimens of limestone to Dr. Jackson.

September 12.—I went down to the end of the bay with Dr. Jackson and Mr. Thayer, and examined slate rock on sections 35 and 36, township 51, range 33. We took specimens, some of which are suitable for whetstones. We returned to the Methodist mission at 2 p. m.

September 13.—Left L'Anse at 8½ a. m. for Portage river, and arrived at Sheldon's at 9½ a. m., and remained till afternoon.

September 14.—Encamped at the mouth of Portage river.

September 15.—Left mouth of Portage river for the Quincy Company's mine. Stopped at the Pennsylvania Company's cabins to dinner, and examined the hills, but saw no copper. The company worked a vein of agate on this location. Proceeded on to Quincy Company's mine, and encamped. This company has sunk a shaft 67 feet deep on a vein of native copper, accompanied by calc spar, laumonite and quartz. Made barometrical observations at the summit of the hill, at shaft, and at Portage lake.

Wednesday, 20th.—I left the Quincy mine in a boat with Dr. Jackson, on our way to Torch lake. Arrived at Douglass Houghton Company's cabin, at the head of Torch lake, at 10 p. m., and camped.

Thursday, 21st.—Left Torch lake with Dr. Jackson—went to falls of Torch river—measured the height of the falls with barometer. Dr. Jackson examined the workings of the mine, and measured and took the course of the drifts, &c. Proceeded to Michigan Company's mine; Dr. Jackson made observations here, and then proceeded on to the Trap Rock Company's cabins; from thence to the Forsyth Company's, where we encamped.

Friday, 22d.—We examined the Forsyth Company's mine, and measured the heights of the hill, and took specimens. Then we went to the Medon works and examined the old furnace, which is fifteen inches square inside and seventeen feet outside. Proceeded by the Albion to the North American Company's mines, and examined all the drifts, measured course and the width of the vein, passing through every part of the mine.

Saturday, 23d.—We visited the Cliff mine, went through all the levels, and collected specimens, and made observations; also at the summit of the cliff, with barometer, and at the base, and remained there for the night. The next day we proceeded to the Eagle river mine, and took specimens of the ore.

September 26.—Left Eagle river and went to Copper Falls mine, and examined the ore heaps, and took specimens. Remained at the mines over night.

Wednesday, 27th.—We left Copper Falls at 5 p. m. for Eagle Harbor, where we remained for the night.

September 28.—Left Eagle Harbor for Copper Harbor, and arrived at 11 a. m.

Observations with barometer.

At base of Torch River falls, on September 21, 10h. 30m. a. m.—B. 29.40; T. 8° C.; t. 44° F.

At summit of falls, Torch river, September 21, 10h. 45m. a. m.—B. 29.282; T. 8°.5 C.; t. 45° F.

At highest point of bluff near the falls, September 21, 11 a. m.—B. 29.264; T. 10° C.; t. 48° F.

At base of the falls of Torch river, September 21, 11½ a. m.—B. 29.40; T. 8° C.; t. 46°.50 F.

At Eagle river, near Cliff mine, September 23.—B. 29.025; T. 13°.5 C.; t. 52° F.

At the main shaft of the Cliff mine, September 23.—B. 28.99; T. 12°.8 C.; t. 52° F.

At the top of the Cliff, on the vein, 10 feet below the highest point of the vein, September 23.—B. 28.79; T. 13° C.; t. 53°.5 F.

At the highest point of the Cliff, 20 rods NE. of the vein, September 23.—B. 28.69; T. 12° C.; t. 51° F.

At the top of the Cliff, on the vein, (returning,) September 23.—B. 28.792; T. 13° C.; t. 52°.5 F.

At the main shaft of the Cliff mine, (returning,) September 23.—B. 28.18; T. 12° C.; t. 51° F.

At Eagle river, (on return,) September 23.—B. 29.623; T. 12° C.; t. 55° F.

Analysis of leonhardite by G. O. Barnes.

A weighed portion of mineral, dried at 100° C., was heated to redness in a platina crucible, to determine loss of water, which was 11.93 per cent. Another portion of the same mineral, dried at 100° C. to expel hygrometric moisture, was treated with chlorohydric acid and water until decomposed; then evaporated to dryness, and redissolved the soluble matter in chlorohydric acid and water, and filtered. The silica remained insoluble. To the filtered solution added ammonia, which precipitated the alumina and peroxide of iron; collected it on a filter, burnt, and weighed it. To the remaining solution added oxalic acid in excess, which precipitated oxalate of lime; collected it on a filter, washed, burnt, and weighed it as carbonate of lime. This analysis gave the following results:

A.
11.93 water.
55.04 silicic acid.
22.34 alumina and peroxide of iron.
10.64 lime.
99.95

Which gives the formula 3 $\dot{c}a\,\ddot{S}i + \ddot{A}t\,\ddot{S}i + 12\,\ddot{\ddot{\ddot{}}}$, which is that of leonhardite.

Analysis of sulphuret of copper ore from Mendenhall's mine, Lake Superior.

A weighed portion of the ore, dried at 100° C., was digested in aqua regia until nothing but the insoluble portion remained, which was filtered off, after first evaporating to dryness and redissolving in chlorohydric acid and water on a weighed filter. Weighed and burnt off the sulphur, which was determined by the loss of weight. To the filtered solution

added a solution of chloride baryum, which precipitates the sulphuric acid as sulphurate baryta; collected on a filter, dried, burnt, and weighed, and then from the amount calculated the sulphur. To the solution added sulphuric acid to remove the excess of baryta; filtered, and through the filtered solution passed sulphuric gas to saturation, and collected the sulphuret of copper on a filter; washed and digested the filter with the precipitate in aqua regia; filtered off and separated the sulphur, and precipitated the oxide of copper from the solution by a hot solution of caustic potash collected on a filter; washed, burnt, and weighed it as oxide of copper; heated the remaining solution to expel the sulphydric acid gas, and added ammonia, which precipitated peroxide of iron and alumina; collected and weighed. Then to the solution added oxalic acid, which precipitated oxalate of lime; filtered, washed, burnt, and weighed the carbonate of lime. This analysis gave the following results:

64.10	sulphate of baryta and silica.
6.19	sulphur.
.64	peroxide of iron.
9.07	lime.
14.03	copper.
6.97	water.
101.00	

Analysis of black sulphate baryta.

A weighed portion was digested in chlorohydric acid; the sulphate baryta remained undissolved, which was collected on a filter and weighed. Added to solution chloride baryum, and collected the precipitate of sulphate baryta, from which I calculated the amount of sulphur; precipitated the copper by sulphydric acid gas in a state of sulphuret, which I collected on a filter and dissolved it in aqua regia, and filtered off from the sulphur. Then added a boiling solution of caustic potash, which precipitated oxide of copper; collected on a filter, burnt and weighed the oxide of copper, from which I calculated the amount of copper. The following results were obtained:

90.64	sulphate of baryta.
1.76	sulphur.
5.19	copper.
2.34	loss—probably sulphur.
99.93	

GEORGE ORVILLE BARNES.

Barometrical observations at various places, by C. T. Jackson.

Date.	Hour.	Place of observation.	Bar.	T.	t.	Remarks.
1847.						
June 22	.....	Below St Mary's falls, at the Sault, 14 inches above river...	29.66	70	°F.	
		Above.....do.....do.....1 foot above the lake	29.69	69	°F.	
25	Noon.....	Grand island, 8 feet above Lake Superior.....	29.502	78 F.		
26	3 p. m.....	Copper Harbor, 1 foot above Lake Superior.....	29.310	78°		
27	3..do.....	Fort Wilkins, 28 feet above Lake Superior. Barom. No. 1..	29.42	21° C	.....	Travelling barometer.
27	3..do.....	.....do.....do.....do.....No. 2..	29.45	21° C.	.....	Stationary barometer.
28	1..do.....	.....do.....do.....do.....No. 1..	29.52	17½ C.	.....	Travelling barometer.
28	1..do.....	.....do.....do.....do.....No. 2..	29.55	17½	.....	Stationary barometer.
30	9¼ a. m.....	Mouth of Eagle river, 5½ ft. above Lake Superior...B. No. 1..	29.45	17 C.	16 C.	
30	10¼.do.....	Office of Lake Superior Copper Company .....do. No. 1..	29.210	22	22	
30	10¾.do.....	.....do.....do.....do.....	29.207	23	22	
July 1	12¼ p. m.....	Boston and Pittsburg Company's office, at the Cliff mine south-west from Eagle river	29.130	24	24½	
1	4¼..do.....	Boston and Pittsburg Company's office, at the Cliff mine.....	29.100	25		
2	.....	Sand bay, near mouth of stream.....	29.530	22	21	
		Copper Falls mine, at office of J. Childe	29.30	24½	25	
5	8¼ a. m.....	Fort Wilkins, 28 feet above Lake Superior.....	29.54	23	23	Dew-point, 13¾ C.
5	5 p. m.....	.....do.....do.....do.....	29.55	84 F.		
8	2..do.....	End of Keweenaw point, 8 feet above lake level.....	29.50	23 C.	23 C.	
8	3¼.do.....	.....do.....do.....do.....	29.490	23 C.	23	
8	9¾.do.....	Lac La Belle, 4 feet above water	29.450	20 C.		
8	9¾.do.....	Lac La Belle Company's office, Sibley's	29.180	19½		
9	9 a. m.....	.....do.....do.....do.....	29.250	21½		
9	3 p. m.....	.....do.....do.....do.....	29.240	25	25½	
		Top of Bohemian mountain	28.625	26½	26	Dew-point, 17½ C.
		Upper mine	28.70	26	25	
		First shaft, Bohemian Company's mine	28.865	26		
10	2 p. m.....	Lac La Belle Company's office, Sibley's.....	29.20	26¾	26¾	Dew-point, 14¼ C.
11	11¼ a. m.....	.....do.....do.....do.....	29.17	27½	27	
		Level of Lac La Belle.....	29.45	29½	29½	
11	5¼ p. m.....	Level of Lake Superior	29.365	29½	23½	
11	.....	Cabin of Alliance Company, Sharwood.....	29.115	25	24	Dew-point, 18½° C.
12	11¼ a. m.....	.....do.....do.....do.....	29.150	28	29	
12	5 p. m.....	Top of Mount Houghton.....	28.58	26½	24	

Barometrical observations at various places—Continued.

Date.	Hour.	Place of observation.	Bar.	T.	t.	Remarks.
1847.						
July 12	.....	Top of Mount Houghton.....	28.57	26	24	
12	.....	.....do.....do.....	28 57	25½	25	
12	8 p. m.....	Cabin of Alliance Company, Sharwood.....	29.25	21	19	
14	2..do.....	Copper Harbor, Fort Wilkins, B. 28 feet above lake	29.44	21	21	Dew-point, 9½° C.
16	Noon.....	Fort Wilkins	29.14	23		
17	11 a. m.....	.....do.....	29.40	21		
18	.....	.....do	29.49	16° C.		
20	Noon.....	La Pointe Fur Company's warehouse.....	29.110	26½	27	
25	9 a. m.....	Isle Royale, Rock Harbor, 8 feet above Lake Superior	29.560	20½	19½	
27	8½ p. m.....	Scovill's point	29.38	13		
28	11½ a. m.....	.....do	29.185	12¾		
	3 p. m.....	.....do	29.095	10		
31	9 a. m.....	.....do	29.110	13		
	1½ p. m.....	.....do	29.170	16½	.....	Storm.
August 1	9¾ a. m.....	.....do	29.395	17°		
2	8..do.....	.....do.....level of Lake Superior.....	29.540	14		
3	7½ p. m.....	Miller's location, Isle Royale, lake level	29.550	19		
4	6 a. m.....	.....do	29.570	15		
4	.....	.....	29.545	21		
	5 p. m.....	Todd's Harbor, Isle Royale.....	29.34	19		
6	6 a. m.....	Card's point	29.36	16½		
7	a. m.....	.....do	29.42	19		
7	10 a. m.....	.....do	29.45	25		
	1 p. m.....	.....	29.455	15		
8	1½ .do.....	.....	29.600	22		
9	10 a. m.....	Card's point.....	29.600	18		
10	6 a. m.....	.....do	29.530	20		
11	9 a. m.....	Rainbow cove.....	29.530	16	15	
11	8 p. m.....	Wright's island, Isle Royale	29.570	19		
12	6 a. m.....	.....	29.460	17		
13	.....	Datholite mines.....	29.270	21	.....	Rain hard, and gales.
13	3 p. m.....	Chippeway harbor, Isle Royale.....	29.112	18	18	
16	.....	Rock Harbor	29.240	18		
18	.....	.....do.....	29.575	18½		

	p. m.					
23	Noon		29.630	17½		
	7 p. m		29.650	19		
24			29.680	19		
25	9h. 45m. a. m.	Ransom's store, 8 feet above lake	29.562	20	19½	Observations for section across Isle Royale.
	10 35..do	1st hill on section across Isle Royale	29.455	21	21½	
	11.....do	2d hill	29.416	22	20	
	11¼.....do	3d hill	29 320	22½	20	
	11½.....do	Brook	29.442	22	21	
	12h. 10m. p. m.	4th hill	29.240	23	21½	
	12 30...do	5th hill	29.030	22½	21	
	12 45...do	6th hill	29.020	22½	21	
	12 50...do	7th hill	29.050	24	22	
	2 15...do	Returning at brook	29.380	23½	21	
	3 50...do	do	29.325	20	19	
	4 45...do.	Ransom's store	29.410	22	18½	

NOTE.—Hourly descent of barometer has been 0.022; hence the measurement will be repeated, with stationary observations at the same time. The observations are taken on the section.—(See Mr. J. Peabody's observations.)

Observations made for a section across Isle Royale, by Joseph Peabody, esq.

Date.	Hour.	Place of observation.	Bar.	T.	t.	Remarks.
1847.						
Aug. 27	7h. 50m. a. m....	Commencement of section by Mr. Peabody at Ransom's, Rock Harbor	29.232	64°.4F.	62°.96F.	0.0
	8 45 ....do....	First ridge	28 97	66.2	62.96	263.7
	9 10 ....do....	Stream called by Mr. Peabody Cold run	29.11	65.5	64.6	120.4
	9 30 ....do....	First prairie	28.96	65.5	64.6	265.2
	10 05 ....do....	Summit	28.715	66.2	62.96	506.1
	10 35 ....do....	Second prairie	28 850	65.5	64.6	371.8
	10 05 ....do....	Low ground	29.127	68.9	68	111.6
	11 25 ....do....	Ridge	28.950	69.8	68.9	288.3
	11 45 ....do....	Next valley	29.190	71.6	70.7	66.3
	12 35 ....do....	Top of look-out	29.00	68.9	67.1	236.5
	12 55 ....do....	Valley beyond	29.145	70.7	68 9	101.7
	1 20m. p. m....	North shore of the island opposite Fish island	29.220	69.8	68.94	See profile pl.
	3 15 ....do....	Summit, on return	28.722	66.2	62.96	
	4 15 ....do....	Ransom's, on return	29.245	62.6	55.40	
		[This section extends from Rock Harbor to the north shore of Isle Royale to Fish island, and was measured along the trail surveyed by L. Ransom, esq., in t. 66, r. 34, sections 22 to 8. It was then extended to Conglomerate bay, section 27.]				
30	Noon	Rock Harbor, 8 feet above lake level	29.55	12°c.		
Sept. 1	Noon.....	.....do.....do.....	29.34	16 C.		
20	.....	Eagle Harbor	29.45	17½°c.		
21	8 a. m.	.....do.....	29 45	16°c.		
	9¼ do.....	One mile from Copper Falls, E. H. road	29.20	19°c.		
	10h. 35m. a. m....	Office, Copper Falls	29.21	19½ c.	19½ c.	
	11 34 ....do....	On road, near large pine tree	29.209	21°c.		
21	1 07m. p. m....	Northwestern Company's office, (Mr. Slawson's)	28.849	21°c.		
	3 04 ....do....	.....do.....	28.80	20½ c.		
	3 30 ....do....	First hill	28.60	19.4 c.		
		Joy's Hotel, Eagle Harbor	29.355	17°c.		

		Trap hill	28.910	21° c.		
		Height of land	28.910	21° c.		
	12h. 48m. p. m.	Summit of the hill	28.830	21° c.		
		Office of Northwest Company, (Stonetenberg's)	28.845	22° c.		
22	.....	.....do.....do	28.870	10° c.		
24	.....	Returning to Eagle Harbor.				
24	10h. a. m.	Office of Northwest Company, (Stonterberg's)	28.750	11° c.		
	11...do	Conglomerate hill	29.080	15° c.	16° c.	
	1 p. m.	Eagle Harbor, 6 feet above lake	29.350	17 c.	13° c.	
25	9 a. m.	Eagle Harbor, Joy's Hotel	29.180	22	.....	Rainy weather.
25	Evening	.....do.....do	29.090	22		
26	a. m.	.....do.....do	29.200	17° c.	.....	Foggy.
27	a. m.	.....do.....do	29.070	15½ c.	.....	Rains.
1848.						
July 5	10 a. m.	Sault Ste. Marie	29.40	18		
6	10..do	.....do	29.20	20		
7	7...do	.....do	29.27	20		
8	6...do	Copper Harbor, Brockway's Hotel	29.54	18 c.		
9	6...do	.....do	29.50	15° c.		
13	8½..do	Fort Wilkins	29.49	18 c.	64 F.	M. Lake, 114½ ft. above
	10..do	Manganese lake	29.36	21 c.	67 F.	Lake Superior.
	Noon	Fort Wilkins	29.48	23 c.	70 F.	
14	9 a. m.	.....do	29.55	18	66	
	Noon	Horse-shoe Harbor	29.85	67 F.	68 F.	Height of hill 641 feet.
	Noon	Top of hill back of Horse-shoe Harbor, (Barnes's obs)	29.17	63	62 F.	
15	Noon	Lake shore opposite Mt. Houghton	29.56	20 c.	64 F.	
	2½ p. m.	Lac la Belle	29.54	19½	78	
	5½..do	Base of Bohemian mountain, 3 feet above Lac la Belle	29.57	22½	67 F.	
	7...do	Lac la Belle Company's office	29.265	20	68	
	8...do	.....do.....do	29.285	21	68	
16	7...do	.....do.....do	29.16			
17	8½..do	.....do.....do	29.08	18° c.		
	9...do	.....do.....do	29.10	20		
	10..do	On section from Lac la Belle to Copper Harbor—first observation at brook	28.88	22	69	
	10½ do	Little Montreal river	29.12	22½ c.		

Observations—Continued.

Date.	Hour.	Place of observation.	Bar.	T.	t.	Remarks.
1848.						
July 17	11¾ p. m.	River, base of ledge	28 92	24	71	
		Under ledge	28.915	22		
	1h. 10m.	Bridge, 8 miles from Bohemian mountain	29.00	22	70	
	2 p. m.	Copper Harbor				
24	3..do	Eagle river, Lake Superior Company's office	28.98	20	68	
	4¼..do	Hill, one mile north of Mr. Pray's house, Suffolk co	28.48	21	68	
	5..do	Pray's house	28.64	20	66	
25	6 a. m.	Mr. Pray's house, Suffolk county	28 96	22	62	
	3 p. m.	.....do.....do	28.962	18	76	
		Mine of Suffolk county	28.98	15	56	
	1 p. m.	At the other mine south of this	28.07	17°		
	2 p. m.	Mr. Pray's house	28.50	19	69	
26	7 a. m.	.....do	28.84	15	55	
	11 do	.....do	28.82	16	61	
	Noon	Hill near Suffolk location	28.42	17	52	
	1h. 10m. p. m.	Buffalo location, Durand's office	28.565	16	65	
	3¼ p. m.	Northwestern Company's location, Slawson's	28.710	18	61	
	5h. 20m. p. m.		28.70	19	64	
28	9 a. m.	Suffolk location, Pray's	28.91	17		
	10 do	.....do	28.92	18½	63	
	Noon	Lake Superior Company's office, Eagle river	29.31	19	64	
30	3 p. m.	Eagle River office	28.875	20	68	
31	Noon		28.87	22		
Aug. 1	9 a. m.	Lake Superior Company's office	29.09	18	65	
	10 do	.....do.....do	29.130	20¾	70	
3	10 do	.....do.....do....246 feet above lake	29.143	21	71	
3	12 m.	Boston and Pittsburg Company's office	29.02	25	79	
3	1 p. m.	.....do.....do	29.02	23		
3	2¼ do	.....do.....do	28.99	24	75° F.	
3	2¾ do	North American Company's office, Judge Bacon's	29.00	25	77	
3	5 do	Albion Company's office, W. Stevens's house	28.845	24	74	
3	6¼ do	Top of hill at the "mine."	28.67	23	70	
3	10 do	Lake Superior Company's office	29.110	21½		
5	Noon	.....do.....do	29.04	26	79	

	Evening	Portage	29.26	23	72	
10	Noon	Lake shore	29.48	17	60	
	Sun set		29.47	15	59	
19	Noon	Fort Wilkins	29.44	19		
Sept. 4	8 a. m	Boston Company's cabins	29.11	20° c.		
	Noon	do	29 13	21½	65	
	3 p. m	do	29.22	20	67	
	5¾ do	do	29.265	17	62	
5	5½ a. m	do	29.440	10	49	
6	5..do		29.67	6° c.		
7	2 p. m	Portage river	29.50	22½ c.	69	
	p. m	do	29.742	21	55	
8	8½ a. m		29.61	15	48	
	do	Meneclier's, L'Anse	29.58	10	48	
8	Noon		29.61	13	55	
13	3 p. m	Sheldon's, Portage river	29.50	16	56	
13	5¾ do	do	29.415	14	56	Storm and gale of wind.
14	8 a. m	do	29.065	11	51	
14	11 do	do	29 095	11	51	
14	Noon	do	29.110	10¾	51	
14	3 p. m	do	29.200	11	51½	
14	4..do	do	29.210	11½	52	
14	6..do	do	29.240	10½	51	Storm over.
15	7 a. m	do	29.410	7½	40½	
15	8..do	do	29.420	9 c.	48	
15	3½ p. m	Quincy mine, Portage lake	28.995	19" c.	61	
15	4¾..do	do	28.950	16	60	
15	6h. 20m. p. m	do	28.900	11	52	
15	Noon	do	28.889	11	53	386 feet above portage lake.
16	8½ a. m	do	28.60	18	55	
	11½ do	do	28.58	19	55	Rainy weather.
	Noon	do	28.57	19	55	
	1½ p. m	do	28.56	17½	54	
17	8½ a. m	do	28.865	15	50	
	Noon	do	28.710	9° c.	54	

Observations—Continued.

Date.	Hour.	Place of obeservation.	Bar.	T.	t.	Remarks.
1848.						
Sept. 18	9 a. m.	Quincy mine, Portage lake	28.870	18	54½	
19	9½ do.	do.	28.820	18	29	
19	4½ p. m.	do	28.840	20	45	
20	7½ a. m.	do	28.885	16	47	
21	7...do.	Torch lake, 5½ feet above lake level	29.615	9	41	
	9¾ .do.		29.662	9	47	
	10h. 5m. a. m.	Section line east and west river—rock sandstone				
	10h. 10m. do.	Douglass Houghton's mine—falls—below falls	29.411	9	44°	
	11¼ a. m.	Top of falls at Douglass Houghton's mine	29.282	8½	45° F.	
	11¾ ..do.	Highest rock over falls	29.264	10° c.	48°	
	11½ ..do.	Base of falls	29.400	8° c.	46	
	1h. 15m. p. m.	Stream near Michigan Company's location	29.580	10	46	
	1h. 50m...do.	Michigan Company's mine at cabins	29.175	10¼	46½	
	3h. 50m...do.	At the stream	29.040	9	44	Observations for a profile of the mines.
	4½ p. m.	Trap Rock river	29.501	9	43	
	5¾ ..do.	Forsyth Company's mine (cabins)	29.298	8½ c.	39	
22	7h. 21m. a. m.	do. do.	29.331	3½	39	
	7h. 40m..do.	Above upper shaft at mines	29.237	6½	46	
	8h. 15m..do.	At upper shaft	29.250	8½	48°	
		2d shaft	29.301	10	48½ F.	
		3d shaft	29.340	11	49	
		Level with the swamp	29.398	11¼	49	
23		Two miles south of Albion Company's mine, (brook)	29.270	13	53	
	10¾ a. m.	Medora Abandoned Furnace	29.300	14	51	
	11h. 5m. a. m.	North American Company's mines	29.295	13°		

	5..do.....	Copper Falls.....	29.180	10	48½	
27	.....	.....do.....at office.....	29.00	5°		
	Noon.....	.....do.....	29.145	6		
	2½ p. m.....	.....do.....	29.182	5½		
	4...do.....	.....do.....	29.162	5° c.		
	5...do.....	Eagle Harbor.....	29.410	4° c.	36 F.	Rain,
	7½..do.....	.....do.....	29.380	½° c.	33½	Storm.
29	5½..do.....	Fort Wilkins, Copper Harbor, bar No. 1.....	29.230	11½ c.		
		Barometer No. 2 compared with No. 1—No. 2.....	29.240	55° F.	.....	Barometers remain nearly as they were originally; difference 0.03 originally; now 0.01+ travelling barometer.

JACKSON COURT-HOUSE,
Jackson County, Ohio, May 23, 18

MY DEAR SIR: I received yours of the 15th instant yesterday, wh my way to Lawrence county to make a geological survey of a fu tract, but returned to send you the notes of last year's observations your barometer, lest, if I delayed till after the survey, it might be to to be useful to you. Some of them are the original papers as register by the side of the instrument at the times specified; others are cc strictly accurate, I believe—as much so as carefully copying and comp can make them. Not hearing from you until now, I had supposed the observations were of but little interest to you, and I sent a co them to Professor Silliman for publication, giving you credit for the in ment you were so kind as to furnish me. I never expected any pa the labor, but did it as a free-will offering, hoping that some benef science might result from it; and, had I expected compensation, I sh not have sent it for publication unless through you. If you can sistently make any compensation, under the circumstances, it will b unexpected favor, and gratefully received. If my services are desi on the survey, and you can give me a suitable position in it and p will go up and aid in its execution.

I remain your friend and servant,

W. M. MATHE

To Dr. C. T. JACKSON.

Comparison of barometers at Copper Harbor, June 27, 1847.

The barometer used by Mr. Mather stood 0.03 inch (three hundre of an inch) higher than the standard barometer.

Day.	6 A. M.			9 A. M.			12 M.		
	Barometer.	Ther.	Winds.	Barometer.	Ther.	Winds.	Barometer.	Ther.	Winds.
		°			°			°	
7	.....	.....	.....	.....	.....	.....	.....	.....	.....
8	29.478	70	SSE.; fresh.....	29.507	78	SSE.; light.....	29.519	79	O; calm.
9	29.505	70	O; calm; little breeze on the lake.	29.569	73	O; clear; little breeze on the lake.	29.540	76	O; calm.
10	29.470	66	O.....	29.491	72	O.....	29.476	71	O.
Sunday, 11	29.470	69	O.....	29.444	70	O.....	29.442	76	W. ½.
12	29.320	70	O; breath S.....	29.358	66	W. by N. 4; fog.....	29.412	74	W. by N. 4.
13	29.654	65	O.....	29.681	66	O.....	29.698	69	O.
14	29.549	66	SW. 4.....	29.516	70	O.....	29 481	74	W. by N. 2.
15	29.288	72	O.....	*29.220	77	SE. 3.....	29.214	74	NW. 2.
16	29.220	70	SW. 2.....	29.160	69	SE. 5.....	29.151	74	SW. 1.
17	29.320	70	SW. 2.....	29.394	70	W. 3.....	29.460	64	W. 2; foggy.
Sunday, 18	29.500	60	NW. 1.....	29.540	68	W. 1.....	29.550	65	NW. 1.
19	29.460	61	S. by W. 3.....	29.450	67	S. by W. 3.	29.438	70	N. by W. 1.
20	29.230	68	S. by E. 1.	29.320	72	W. 2.....	29.300	76	SE. 3.
21	29.100	72	W. 1.....	29.101	73	W. 6..	29.174	75	W. 6.
22	29.470	60	W. 4.....	29.530	64	W. 4.....	29.550	68	W. 4.
23	29.550	65	SW. 3.....	29.556	70	W. 3.....	29.558	73	W. 3.
24	29 486	71	SE. ½.....	29.465	73	S. by E. 2.....	29.450	76	SW. 1.
Sunday, 25	29.250	66	O.....	29.320	62	NW. 1.....	29.416	65	NW. 3.
					51 D	Heavy swell—rain.....	.....	49	Heavy swell—rain.
†26	29.670	56	NW. 1.....	29.760	62	NW. 1.....	29.710	66	W. 1.
		48	Clear.	.....	60				
27	29.596	57	SW. 1.....	29.630	62	S. 2.....	29.600	67	SSE. 3.
28	29.280	60	SSW. 4; cloudy.....	29.264	65	S. 5; cloudy.....	29.260	68	S. 2; cloudy.
29	28.069	61	W. 4; cloudy in parts	29.000	64	W. 5; cloudy, but moon sh.	29.032	67	W. 6; fleecy clouds.
30	29.031	56	W. 5.....	29.040	64	W. 5.....	29.050	70	W. 5.
			Storm.....	.....	50 D	Storm.....	Propeller.	50	Storm.
31	29.094	55	W. 2.....	29.170	60	W. 3.....	29.250	70	W. 3; cloudy.
		49	Storming.....	.....	51	Cloudy			

*Barometric wave raised water in the harbor, at 9 a. m., a foot in a few minutes, and fell some in a few minutes. † Frost on the morning of July 26.

Barometrical register—Continued.

Day.	3 P. M.			6 P. M.			9 P. M.		
	Barometer.	Ther.	Winds.	Barometer	Ther.	Winds.	Barometer.	Ther.	Winds.
		°			°			°	
	.....	.....	.....	.....	.....	.....	29 465	68	SE. fresh.
8	29.466	75	O; calm.....	29.450	71	SE. 2.....	29.450	68	SE. 4.
9	29.479	70½	O; slight breath N.....	29.468	74	SSE. 3.....	29.401	74	O.
10	29.460	73	O.....	29.429	70	O.....	29.412	67	O.
Sunday, 11	29.408	74	W.; waves break; water very smooth.	29.350	75	SSE. 3.....	29.351	73	SSW. 5.
12	29.460	76	W. 3.	29.508	72	W. by N. 3.....	29.548	67	O.
13	29.654	64	O.....	29.605	68	O.....	29.605	70	O.
14	29.448	73	O.....	29.353	73	SSE. 1.....	29.360	80	SSE. 1.
								70*	detached.
15	29.170	68	S. by W. 6.....	29.150	70	O.....	29.308	70	SSW. 1.
16	29.159	73	S. by W. 1.....	29.130	72	W. 1.....	29.150	72	SSW. 2.
17	29.480	64	W. by N. 1.....	29.530	68				
Sunday, 18	29.540	68	NW. 1.....	29.510	63	NW. 1.....	29.510	66	O.
19	29.368	69	W. 1.....	29.348	.....	S. 4.....	29.34	65	SW. 1.
20	29.232	82	SE. 2.....	29.168	80	SE. 4.....	29.170	78	SW. 3.
21	29.220	74	W. 5.....	29.240	72	W. 4.....	29.296	67	W. 4.
22	29.550	70	SSE. 1.....	29.520	70	NW. 4.....	29.526	68	SSW. 3.
23	29.548	76	W. 2.....	29.508	73	SSW. 3.....	29.430	70	SSW. 1.
24	29.371	72	S. by W. ½.....	29.328	70	O.....	29.281	69	O.
Sunday, 25	29.500	60	NW. 5.....	29.541	62	NW. 4.....	29.587	62	O.
		48	.....	Clear....	49	Heavy sea	.....	47	
26†	29.690	68	W. 1.....	29.680	60	W. 1.....	29.670	70	O.
27	29.500	68	SE. 4; cloudy.....	29.440	64	SE. 4.....	29.440	64	SW. 1.
					59	Storm coming.....	rain at 7p.m	.....	Cloudy.
28	29.224	66	O; cloudy.....	29.169	66	O; clear; cloudy in NW. and NE.	29.132	65	S. 3; heavy clouds to N. and W.
29	29.050	64	W. 3; cloudy.....	29.076	62	W. 7; storming.....	29.099	69	W. 7.
30	29.069	66	W. 1; cloudy.....	29.080	70	W. 1; storming.....	29.091	68	W. 2.
					48	.....	.....	50	Storm.
31	29.272	67	W. 3; clear.....	29.200	70	.....	29.331	68	O; clear.
					71			54	

Barometrical register at Porter's island, [illegible] August, 1847—latitude 47° 28', longitude —

Day.		Barometer—6 A. M.	Thermometer, attached.	Thermometer, detached.	Winds, &c.	Barometer—9 A. M.	Thermometer, attached.	Thermometer, detached.	Winds, &c.	Barometer—12 M.	Thermometer, attached.	Thermometer, detached.	Winds, &c.
Sun.	1	29.381	60	56	O., fleecy clouds	29.444	67	57	W. 1, fl. cl.	29.458	68	62	W. 2, fleecy clouds, some cumuli in W., SW., and W., WNW., N., and NE.
	2	29.540	60	....	O., clear	29.568	64	....	S. 1, fog bank	29.590	69	65	SSE. 1, clear.
	3	29.560	61	....	O., clear	.....	....	....	E. ½, clear	.....	....	....	E. ½, clear.
	4	.....	....	....	Storm in night; stormy	.....	....	....	Stormy	.....	....	....	Stormy.
	5	.....	....	....	Foggy and drizzling	.....	....	....	Fog, and drizzling	.....	....	....	Cloudy.
	6	.....	....	....	Foggy	.....	....	....	Foggy	.....	....	....	Clear.
	7	.....	....	....	W., clear	.....	....	....	O., clear	.....	....	....	O., clear.
Sun.	8	.....	....	....	W. 1, clear	.....	....	....	E. 2, clear	29.610	68	....	E. 5, clear.
	9	29.589	64	....	S. 2, flocculi	29.610	70	....	S. 3, clear	29.504	74	...	S. by E. 3, clear.
	10	29.524	58	....	S. by W. 3, clear	29.604	74	....	S. 1, clear	29.541	75	....	O., calm, cumuli in W.
	11	29.508	67	....	O., cirri	29.510	66	....	O., dense fog	29.564	69	....	O., cirri, sun shone a little.
	12	29.562	65	....	O., clear	29.568	60	....	N. 1, very foggy	.....	....	....	NE. 3, very foggy.
	13	29.294	66	....	S. by E. 3, cirri	29.270	68	....	S. by E, cloudy	29.250	70	....	O., cloudy, thunder in W.
	14	29.318	64	....	S. by W. 5, clear	29.309	70	....	Calm	29.330	76	....	W. 5, clear.
Sun.	15	29.341	70	....	SW. 1, rain	29.350	70	....	W. 2, clear	29.351	73	....	WNW. 3, clear, few cirri.
	16	29.330	65	....	O., cloudy	29.326	66	....	O., cloudy, thunder	29.314	64	....	E. 1, thunder shower and lightning in W. at 10 to 11 a. m., heavy at 12 30'.
	17	29.320	60	....	W. 5, cloudy	29.350	63	....	W. 4, cloudy, occasional sunshine.	29.400	62	....	W. 4, cloudy.
	18	29.561	58	....	NW. 5, clear	29.615	67	....	NW. 5, clear	29.680	67	....	WNW. 5, clear.
	19	29.501	58	....	W. 4, clear, a few cirri	29.480	65	....	W. 5, clear, few cirri	29.474	67	....	W. 5, clear.
	20	29.410	65	....	W. 2, clear	29.414	68	....	W. 2, clear	29.406	69	....	W. 3, cirri.
	21	29.371	62	....	W. 2, clear	29.380	67	....	W. 5, clear	29.391	69	....	W. 3, clear.
Sun.	22	29.550	65	....	O., clear	29.560	66	....	E. 3, clear	29.581	67	....	ENE. 3, clear.
	23	29.640	65	....	S. 1, clear	29.650	69	....	S. 1, clear	29.660	74	....	E. 3, clear.
	24	29.701	66	....	O., clear	29.712	68	....	O., clear	29.704	70	....	E. 3, clear.
	25	29.632	70	....	S. 3, clear	29.610	74	....	SSW. 6, clear	29.540	77	....	SSE. 5, cirri.

Barometrical register—Continued.

Day.	Barometer—6 A. M.	Thermometer, attached.	Thermometer, detached.	Winds, &c.	Barometer—9 A. M.	Thermometer, attached.	Thermometer, detached.	Winds, &c.	Barometer—12 M.	Thermometer, attached.	Thermometer, detached.	Winds, &c.
26	29.300	71	....	SW. 6, cloudy, rains a little.	29.344	68	....	W. 5, rain.....	29.410	68	....	W. 4, cloudy, but some blue sky.
27	29.350	60	....	SW. 5, clear.....	29.300	64	....	W. 7, clear.....	29.280	67	....	W. 7, clear.
28	29.516	57	49	W. 1, clear.....	29.558	66	52	W. 1.....	29.564	67	55	NNW. 2, clear.
Sun. 29	29.490	54	50	S. by W. 3, cloudy...1....	29.500	59	55	S. by E 5, cloudy.....	29.478	64	57	S. by E. 3, rain severe 10 a. m.
30	29.420	55	48	NW. 4, cloudy.....	29.450	62	56	NW. 5, clear.....	29.560	66	56	NW. 5, clear.
31	29.600	65	58	S. 3, cloudy	29.580	68	68	S. 4, clear.....	29.550	67	....	SW. 5, clear in spots.
Sept'r 1	29.250	63	60	W. 3, clear.....	29.350	66	58	W. 4, cloudy	29.380	68	....	O., some clouds.
2	29.392	57	....	S. 5, cloudy, clear at 5 a. m.	29.360	60	....	S. 4, raining.....	29.270	74	55	E 5, raining, thunder in S.
3	29.500	57	....	N. 3, clear.....	29.528	60	....	N. 3, clear.....	29.626	63	....	N. 3, clear.
4	29.533	52	48	S. 1, cloudy	29.528	61	52	E 2, cloudy.....	29.485	53	....	E. 4, cloudy.
5	29.320	52	48	SE. 1, cloudy.....	.....	...	....	.....	.....	....	....	

Day.		Barometer—P. M.	Thermometer attached.	Thermometer detached.	Winds, &c.	Barometer—P. M.	Thermometer attached.	Thermometer detached.	Winds, &c.	Barometer—P. M.	Thermometer attached.	Thermometer detached.	Winds, &c.
Sun.	1	29.468	62	62	W. 2	29.470	62	62	O., clear	29.500	64	60	Clear.
	2	29.570	65	65	ENE. 3, clear	29.560	65	65	S. 2, clear	29.550	62	60	S. 5, clear.
	3	.....	....	....	E. 1, clear, cumuli in W.	.....	....	...	S. 2, clear, cumuli in W.	.....	....	....	O., clear.
	4	.....	....	....	Stormy	.....	....	....	Stormy	.....	....	....	Stormy.
	5	.....	....	....	Clear	.....	....	....	Clear	.....	....	....	Clear.
	6	.....	....	....	Clear	.....	....	....	Clear	.....	....	....	Clear.
	7	.....	....	....	S. 1, clear, few cumuli in W.	.....	....	....	E. 1, cumuli in W.	.....	...	....	E. 1, cloudy in W. and S.
Sun.	8	29.604	70	....	E. 4, clear	29.588	66	....	E. 3, clear	29.610	68	....	E. 1, clear.
	9	29.599	74	....	S. by E. 4	29.580	70	....	E. by S. 3	29.560	66	....	S. by E. 4, clear.
	10	29.548	76	....	W. 3, squally in W., threatening rain.	29.573	70	....	W. 3, cloudy, threatening rain.	29.516	68	....	W. 2, cloudy.
	11	29.510	60	....	O., clear	29.526	68	....	O., clear	29.522	64	....	O., clear.
	12	29.500	60	....	NE 3, very foggy	29.470	60	....	N. 1, clear, few cirri	29.460	60	....	S. 3, some clouds.
	13	29.240	70	...	W. 1, rain and fog 2 to 3	29.294	63	....	W. 1, fog and rain	29.338	64	....	O., foggy.
	14	29.340	76	....	W. 4, clear	39.330	75	....	NE. 3, clear	29.300	70	....	SE. 1, clear.
Sun.	15	29.350	72	....	Calm, wind ENE. at 4 p m.	29.344	68	....	S. by W. 1, clear	.....	....	....	
	16	29.230	63	..	Squalls and calm, NW. 6	29.300	60	....	N. 4	29.330	65	....	WNW. 1, cloudy.
	17	29.450	62	....	W. 4, cloudy, bl. squall cl. in W,	29.470	61	....	W. 4, cloudy	29.500	60	....	W. 5, cloudy.
	18	29.585	64	....	WNW. 5, clear	29.560	60	....	WNW. 4, clear	29.564	60	....	
	19	29.410	71	....	W. 5, clear	29.416	67	....	W. 3, some cirri	29.410	66	....	W. 1, cumulo strati.
	20	29.396	69	....	W. 3, cirri	29.400	67	....	ESE. 1, clear	29.401	66	....	O., clear.
	21	29.450	72	....	W. 1, clear	29.450	66	....	O., clear	29.450	66	....	O., clear.
Sun.	22	29.580	67	....	ENE. 3, clear	29.560	65	....	E. 2, clear	29.564	62	....	O., clear.
	23	29.628	64	....	E. 4, clear	29.650	64	....	S. by E. 3, clear	29.650	65	....	S. by E. 2, clear.
	24	29.672	67	....	E. 4, clear	29.674	66	....	E. 2, clear	29.680	64	....	S. by E. 1, clear.
	25	29.486	80	....	ESE. 5, cirri	29.400	76	....	SSE. 6, cloudy	29.364	76	....	SSW. 5, cloudy.
	26	29.450	68	....	W. 4, clear	29.474	68	....	W. 3, clear	29.466	69	....	W. 2, clear.
	27	29.280	77	....	W. 7; cumuli W.; shifted to NW. at 4 p. m.—therm'r fell 10° in a moment.	29.350	70	52	N. 8, squall clouds in NW. and S., fine for comfort.	29.491	48	....	N. 5, cloudy.

Barometrical register—Continued.

Day.	Barometer—3 P. M.	Thermometer, attached.	Thermometer, detached.	Winds, &c.	Barometer—6 P. M.	Thermometer, attached.	Thermometer, detached.	Winds, &c.	Barometer—9 P. M.	Thermometer, attached.	Thermometer, detached.	Winds, &c.
28	29.530	63	63	NNW. 2, clear.....	29.526	70	55	S. 1, clear.....	29.540	62	48	S. 1, clear.
Sun. 29	29.464	72	53	ENE. 2, storming.....	29.400	70	....	ESE. 3, storm.....	29.386	66	52	ESE. 2, storm.
30	29.570	61	....	WNW. 3, cloudy.....	29.588	66	56	SW. 3, cloudy.....	29.621	66	60	O, cloudy.
31	29.458	65	....	SW. 4, cloudy.....	29.400	66	60	SW. 4, cloudy.....	29.350	62	60	SW., cloudy.
Sept. 1	29.380	65	....	W. 1, clear.....	29.400	60	....	O., clear, except clouds in W.	29.415	66	....	O., clear.
2	29.261	68	54	E. 6, severe storm, heavy rain.	29.180	67	52	NE. 7, severe storm of rain and wind.	29.178	65	50	N. 7, severe rain storm.
3	29.621	60	....	NE. 2, clear.....	29.601	60	54	S. 1, clear.....	29.630	62	42	O., clear.
4	29.430	52	....	E. 6, cloudy and rain.....	29.424	53	....	E. 4, cloudy.....	29.415	54	50	E. 4, cloudy.

Dates.	Time.	Barometer.	Thermometer.	Winds.	Barometric tides.	Remarks.
July 15	6 a. m.....	29.288	72°	O.		
	9 a. m.....	29.220	77	.....	Water raised in harbor one foot in two minutes, and in a few moments half a foot more; and fell in a few minutes more one foot lower than usual.	
	10 a. m.....	29.200	80	SE. 5.....	Water higher than usual, though the wind is off shore.	Wind blowing towards west. Heavy thunder storm in west and northwest.
	11h. 15m....	29.480	.....	SE. 4.....	Water suddenly fell about one foot. Strong current along shore to east, on outside island.	
	11h. 20m....	29.264	78	NW. 9.....	Water running into bay with great velocity...	Constant roar of thunder, and very sharp lightning. Wind came in an instant from northwest, a powerful blast, uprooting trees, blowing down tents, and making the lake a sheet of foam. Heavy rain.
	11h. 25m....	29.260	.....	NW. 9.		
	11h. 40m....	29.356	.....	NW. 8.		
	11h. 50m....	29.316	.....	Lull of wind	.....	Another gust just coming on.
	11h. 55m....	29.328	.....	Calm.		
	12h. 5m....	29.300	.....	Calm.		
	12h. 8m....	29.260	.....	Calm.....	Water one foot lower in bay than usual, and flowing in from lake with a strong current.	Clearing in northwest, and sun soon came out.
	12h. 15m...	29.256	.....	Calm.....	.....	O.
	12h. 20m....	29.250	74	Calm.....	.....	Clear in north and northwest. Heavy thunder to east, and northeast, and southeast.
	12h. 30m....	29.251	.....	Calm.....	Water high on lake shore, and flowing rapidly into the harbor.	
	12h. 40m....	29.236	73	Calm.....	.....	Clear in north and northwest.
	1 p. m.....	29.22	.....	SSE 1.....	.....	Clear in north and northwest.
	1h. 40m....	29.206	70	SSE 2.....	.....	Another shower apparently coming from south-southwest and southwest.
	2h.....	29.200	69	S. by W. 4.		
	2h. 15m...	29.200	68	S. by W. 4.	Water high in bay.	
	2h. 20m....	29.200	68	S. by W. 4.	Water fell 9 inches in 5 minutes in harbor, and 9 inches still lower on outside of island.	

Register of observations—Continued.

Dates.	Time.	Barometer.	Thermometer.	Winds.	Barometric tides.	Remarks.
July 15	2h. 22m....	29.204	68	S. by W. 5.	Water four inches lower than at 2h. 20m.....	Very stiff breeze: white caps all over the bay.
	2h. 25m....	29.200	.....	S. by W. 6.	Water stationary in bay—up, on lake shore..	Do do do.
	2h. 30m....	29.200	.....	S. by W. 6.	Water rising in bay rapidly.	
	2h. 35m....	29.192	.....	S. by W. 6.	Water risen six inches in bay.	
	2h. 40m....	29.190	68	S. by W. 6.	Water fallen again eight inches.	
	2h. 50m....	29.172	68	S. by W. 6.	Water risen one full foot.	
	2h. 55m....	29.170	68	S. by W. 6.	Water still up—falling a little.	
	3h.....	29.170	68	S. by W. 6.	Water fallen one foot.	
	3h. 20m....	29.190	68	S. by W. 6.	Water fallen one foot more than last.	
	3h. 30m....	29.182	68	S. by W. 6.	Water risen one foot.	
	3h. 40m....	29.180	.....	S. by W. 6.	Water fallen one and a half feet.	
	3h. 50m....	29.18	.....	S. by W. 6.	Water risen one and a half feet.	
	4h. 10m....	29.176	.....	SSW. 4....	Water rising and falling one foot every few minutes.	
	4h. 20m....	29.170	.....	S. by W. 4.		
	5h. 50m....	29.15	70	O.....	Water two feet below; boats dry out of water.	Perfect calm. Heavy wind clouds, apparently, to south and southwest. Looks as if there was a storm to south and southwest rapidly coming on.
	9h.....	29.300	70	SSW. 1....	.....	Thunder cloud in west.
	10h.....	29.20	70	SSW. 1.		
July 16	1h. 40m....	29.200	.....	NW. 6.....	.....	Thunder had been rumbling and roaring for two hours in west. Heavy driving rain.
	2h. 20m....	.....	.....	NW. 9.....	.....	Heaviest wind and rain at 2h to 2h. 40m., and heavier than that yesterday at 11h. to 12h.
	6h.....	29.220	70	SW. 2.		
	8h.....	29.190	72	SE. 1.		
	9h.....	29.160	69	SE. 5.....	Water at medium height.	
	12h.....	29.151	74	SW. 1.		
	12h. 30m....	.....	.....	.....	Water very high in bay.	
	12h. 35m....	.....	.....	.....	Water gone down one foot.	
	4h. 25m....	29.15	70	.....	.....	Raining gently. Thunder in west.
	[illegible]	29.198	70	.....	.....	

	8h.	29.15	72	.....	.....	Raining gently. Clear in ... Thin clouds in Wind southwest by south 3. west and north, and rainbow visible.
	8h. 35m....	29.15	74	.....	.....	Calm.
	10h. 10m....	29.17	72	.....	.....	Calm.
July 17	9h. 40m....	29.42	69	W. 4.		
	10h. 30m....	29.45	67	W. 4.....	.....	Fog coming on.
	1h. 40m....	29.48	64	W. 1.		
	2h.....	29.48	64	W. 1.....	.....	Raining a little.
	4h. 30m....	29.49	64	NW. by W. 1.	.....	Raining a little.
July 18	10h. 40m....	29.548	66	W. 1.....	.....	S. B. Julia Palmer arrived at 7 a. m.
	12h 30m....	29.54	64	NW. 1.....	.....	S. B. Julia Palmer left at 11 a. m.
	3h. 30m....	29.53	68	NW. 1.....	.....	Temperature of lake water on shore, 62° F.
	5 p. m.....	29.52	64	NW. 1.		
	5h. 45m....	29.51	64			
July 19	10h. 40m....	29.44	69	NW. 1.....	.....	Temperature of lake on shore, 65° F. Algonquin arrived.
	2h 20m....	29.412	69	NW. 1.		
	4h.....	29.36	69	E.....	.....	Wind in a few moments shifted to southeast.
	5h.....	29.348	70	S. 4.....	.....	Temperature of water on shore, 64°.
July 20	1h 30m. p.m	29.265	.....	SE. 5.		
	9h. 40m.....	29.17	.....	SW. 4.....	.....	Halo around the moon.
July 21	8h. 30m. a.m.	29.10	.....	WNW. 5.		
	11 a m ...	29.16	.....	WNW. 5.		
	7h. 40m. p.m.	29.264	.....	W. 5.....	Sudden fall of water in bay of eight inches.	
July 22	11 a. m.....	29.556				
	6h. 40m. p.m.	29.55	.....	NW. 1.....	.....	Squally to north. Thunder clouds to north, northeast, and northwest. Temperature of water, after two days of westerly winds, 60° Fahrenheit.
July 23	1h. 30m. p.m.	29.425	72	Calm.	.....	Cloudy.
July 24	2h 30m. p.m.	29.36	72	S by W. 3.	.....	Raining a little.
July 25	8h. 30m. a.m.	29.266	63	NW. 1.....	Water in bay was one foot above usual level at this time, and soon fell.	Lake rough, from wind at a distance.
	11 a. m.....	.....	.....	.....	Water one foot above usual level, and fell in a few minutes.	
July 29	4h. 30m. a.m.	28.971	62	SW. 4.....	.....	Rained hard last night. Heavy, angry-looking clouds in east. Storm began in morning at 9, but did not rain till 1 p. m. Fine misty rain, and continued blowing hard and raining at 10 p. m.
	10 p. m.....	29.090				

Barometrical and thermometrical observations made at Fort Wilkins, twenty-six feet above the level of Lake Superior, by Joseph S. Kendall.

Day and date.	Hour.	Standard barometer.	Thermometer—Cent.	Newman's iron cistern barom.	Thermometer—Fahr.	Temp. outside.	Remarks.
		Mil.	°	*Inches.*	°	°	
Friday, July 14, 1848.....	11 a. m.	753.00	17.5	29.60	64	.....	
	12	753.00	17.5	29.62	64	.....	
	1 p. m.	753.00	18	29.62	64	.....	
	2	753.00	.....	29.62	66	.....	
	3	753.00	19	29.58	68	.....	
	4	753.00	20	29.58	68	.....	
	5	753.00	.....	.....	.....	.....	
	6	752.10	21	29.564	70	.....	
Saturday, July 15, 1848.....	7 a. m.	748.5	18	29.45	66	.....	
	8	748.5	18	.....	.....	.....	
	9	748.5	16	29.47	66	.....	
	10	748.5	18	29.48	64	.....	
	11	748.5	16	29.51	64	.....	
	12	748.5	16	29.522	66	.....	
	1 p. m.	749.75	16	29.522	64	.....	
	4	750.15	18	29.52	66	.....	
	5	750 00	20	29.56	70	.....	
	6	749 75	20	29.553	69	.....	
	7	.....	.....	29.556	68	.....	
	9	749.75	16	29.556	66	.....	
Sunday, July 16, 1848.	8 a. m.	750.5	15	29.562	60	.....	Fair; wind west, high.
	9	751 00	16	29.568	62	.....	
	10	751.00	17	29.56	63	.....	
	11	751.15	17	29.556	64	.....	Fair; west wind.
	12	751.15	17	29.556	64	.....	
	1 p. m.	751.00	17.5	29.55	66	.....	
	3	749.75	18	29.50	65	.....	High west wind.
	4	749.50	19	29.474	66	.....	
	5	749.00	19	29.45	66	.....	
	8	748.25	19	29.444	67	.....	

	2 p. m.	745.75	18	29.39	63	.....	
	3	746.25	.....	29.39	63	.....	
	4	746.25	.....	29.38	64	.....	
	5	746.25	.....	29.38	64	.....	
	6	746.25	.....	29.38	64	.....	
	7	746.25	19	29.36	66	.....	
Tuesday, July 18, 1848.....	8 a. m.	745.75	20	29.35	68	.....	
	9	745.75	21	29.37	70	.....	Cloudy; fresh breeze northwest.
	10	746.45	20	29.38	68	.....	
	11	746.45	20	.....	.....	.....	
	12½	746.50	20	.....	.....	.....	
	2 p. m.	745.50	24	.....	.....	.....	
	3	745 75	25	.....	.....	.....	
	4	745.75	25	.....	.....	.....	
	5	745.50	24	.....	.....	.....	
	6	745.50	23	.....	.....	.....	
	7	745.00	25	.....	.....	.....	
	8½	744.00	26	.....	.....	.....	
Wednesday, July 19, 1848...	9 a. m.	744.50	20	29.30	70	.....	
	10	744.25	22	29.28	72	.....	
	11	744.00	24	29.28	74	.....	
	12	744.00	25	29.28	76	.....	
	1 p. m.	744.00	27	29.28	80	.....	
	2	744.00	28	29.28	82	.....	
	3	744.00	24	29.28	76	.....	
	4	744.00	25	29.30	76	.....	
	5	744.00	27	29.28	78	.....	
	6	743.25	27	29.25	80	.....	
	7	742.50	.....	29.22	80	.....	
	9	741.50	23	29.18	74	.....	
Thursday, July 20, 1848.....	7 a. m.	740.25	21	29.140	68	63	Fair; west wind.
	9	740.50	20	29.164	66	66	Cloudy; west wind.
	10	740.50	20	29.180	68	64	Cold and raw; dew-point 59½.
	11	741.50	20	29.212	68	66	Strong west wind.
	12	742.35	22	29.252	70	65	Cloudy.
	1 p. m.	742.50	20	29.270	68	66	Northwest wind.
	2	743.00	22	29.300	68	64	Do.
	3	743.30	19	29.308	68	63	Do.

Barometical and thermometical observations—Continued.

Day and date.	Hour.	Standard barometer.	Thermometer—Cent.	Newman's iron cistern barom.	Thermometer—Fahr.	Temp. outside.	Remarks.
		Mil.	o	*Inches.*	o	o	
Thursday, July 20, 1848.....	4 p. m.	743.50	19	29.316	66	64	Northwest wind.
	5	743.75	18	29.308	64	59	Do.
	6	743.75	18	29.308	64	57	Do.
	7	744.00	18	29.328	64	54	Wind north.
	8	744.50	17	29.34	63	52	Do.
Friday, July 21, 1848.....	8 a. m.	747.35	15	29.424	59	48	Fire in office; strong north wind; cold.
	9	748.00	20	29.451	68	51	Do do do.
	10	748.75	25	29.50	82	52	Clouds thinner.
	11	749.50	19	29.472	70	52	Do.
	12	749.00	19	29.474	68	55	Do.
	1 p. m.	749.00	19	29.470	68	57	Sun shines.
	2	749.25	19	29.460	64	58	Do.
	3	749.00	17	29.460	64	60	North wind.
	4	748.50	16	29.450	62	61	Do.
	5	748.50	16	29.450	62	60	Do.
	6	748.25	16	29.440	60	60	West wind.
	7	748.25	17	29.430	64	60	Do.
	8	748.25	16	29.430	62	.....	Do.
Saturday, July 22, 1848.....	8 a. m.	748.50	18	29.47	66	.....	Do.
	9	749.00	18	29.49	68	58	Cloudy.
	10	749.00	18	29.49	66	61	Thin clouds; sun shines.
	11	749.00	18	29.49	66	62	Northwest wind.
	12	749.00	18	29.49	66	64	Do.
	1 p. m.	749.00	16	29.49	64	65	Do.
	2	749.00	16	29.49	64	65	
	3	749.25	18	29.49	64	68	Do.
	4	749 25	18	29.47	64	68	Do.
	5	749.00	18	29 48	64	69	
	6	749.00	17	29 47	64	62	Strong west wind.
	7	749.00	18	29.46	64	62	
	8	748.75	18	29.46	68	55	West-northwest wind.
Sunday, July 23, 1848.....	8 a. m.	749.00	17	29.48	62	56	Fair; south wind.
	9	749.50	18	29.49	64	60	Dr. J. leaves.

	2	748.75	21	29.46	70	75	Do do.
	3	748.75	21	29.46	70	76	Do do.
	4	748.50	20	29.45	68	75	Do do.
	5	748.00	21	29.43	70	76	Do do.
	6	748.00	20	29.43	70	69	Do do.
	7	747.50	19	29.42	68	67	Do do.
	8	747.50	18	29.42	64	62	Do do.
	9	747.00	16	29.38	60	60	Do do.
Monday, July 24, 1848.....	8 a. m.	742.75	17	29.23	62	60	Raining; south wind.
	9	742.50	17	29.22	62	60	South wind.
	10	742.35	17	29.212	62	60	Rain ceased.
	11	742.00	17	29.212	64	62	Water at end of pier 56°.
	12	742.00	17½	29.212	64	62	Misty.
	1 p. m.	742.00	18	29.212	64	65	Clouds thinner.
	2	742.00	18	29.212	64	65	Southwest wind.
	3	742.00	19	29.212	66	72	Sun shines.
	4	742.00	22	29.212	68	76	Do.
	5	742.00	21	29.212	70	74	Do.
	6	743.25	21	29.262	70	67	West wind; cloudy.
	7	743.50	19	29.284	68	63	Do do.
	8	743.50	18	29.302	64	61	
	9	744.00	19	29.330	66	58	Strong west wind.
Tuesday, July 25, 1848.....	8 a. m.	749.00	13	29.542	56	51	Fair; west wind.
	9	749.00	13	29.542	56	52	
	10	751.75	14	29.562	58	55	West-northwest wind.
	11	751.50	14	29.562	56	57	
	12	751.25	14	29.572	57	60	
	1 p. m.	751.00	14	29.57	58	59	Cloudy.
	2	751.00	14	29.56	58	64	Do.
	3	751 00	15	29.56	59	62	Do.
	4	751.00	15	29.56	60	63	Do.
	5	751.00	15	29 56	60	60	Do.
	6	750.50	15	29.534	60	61	South wind.
	7	750.50	15	29.542	60	59	Do.
	8	750.00	15	29.520	58	56	Do.
	9	749.75	14	29.522	57	55	South-southeast wind.

Barometrical and thermometrical observations—Continued.

Day and date.	Hour.	Standard barometer.	Thermometer attached—Cent.	Newman's iron cistern barometer.	Thermometer attached—Fahr.	Temp. outside.	Remarks.
		Mil.	°	*Inches.*	°	°	
Wednesday, July 26, 1848...	8 a. m.	748.00	15	29.45	58	56	South wind; fresh; cloudy.
	9	745.75	15	29.412	58	60	Do do.
	10	745.75	15	29.412	58	60	Do do.
	11	745.75	15	29.406	58	60	Calm.
	12	745.75	15	29.406	58	61	Cloudy.
	1 p. m.	745.75	16	29.376	60	65	Northwest wind.
	2	745.75	15	29.376	60	61	
	3	745.50	16	29.362	60	62	
	4	745.25	16	29.344	60	61	North-northwest wind.
	5	744.50	16	29.314	62	67	Sun shines.
	6	744.25	17	29.300	62	68	North wind.
	7	744.00	17	29.292	64	64	Do.
	8	743.75	16	29.282	62	60	Do.
Thursday, July 27, 1848.....	8 a. m.	742.00	15	29.212	60	55	West wind; fair.
	9	742.00	16	29.212	60	58	
	10	742.00	16	29.254	62	60	
	11	742.25	16	29.264	60	61	West-southwest wind.
	12	742.50	16	29.274	61	62	Stiff breeze.
	1 p. m.	743.40	16	29.304	61	65	Do.
	2	743.50	17	29.316	62	66	Do.
	3	745.00	17	29.330	62	70	Do.
	4	745.25	18	29.340	64	70	Do.
	5	745.50	18	29.354	64	68	Fresh breeze.
	6	745.50	19	29.354	66	67	Calm.
	7	745.25	19	29.362	66	66	Do.
	8	745.25	18	29.362	64	63	Do.
	9	745.25	17	29.374	64	58	Southwest wind.
Friday, July 28, 1848	8 a. m.	747.85	16	29.484	62	60	West wind; fair.
	9	749.75	17	29.514	64	62	
	10	749.75	17	29.520	64	64	
	11	750.00	19	29.550	66	67	North-northwest wind.
	12	750.00	19	29.552	66	67	Do do.

	4	750.00	20	29.552	68	75	Do do.
	5	750.00	20	29.552	68	74	Northwest wind.
	6	750.25	20	29.564	66	74	
	7	750 00	20	29 564	68	69	
	8	750.00	19	29.564	66	64	
	9	751.00	18	29.564	68	58	
Saturday, July 29, 1848.....	8 a. m.	751.25	17	29.572	64	56	Southwest wind.
	9	751.25	17	29.572	62	58	Do.
	10	751.00	17	29.564	63	60	Do.
	11	751.00	17	29.564	63	66	Northwest wind.
	12	751.25	18	29 564	64	66	West wind.
	1 p. m.	751.25	18	29.564	64	66	
	2	751.00	18	29.556	65	67	
	3	750.75	18	29.540	65	68	West-northwest wind; cloudy.
	4	750.25	19	29.514	66	71	Do do.
	5	750.00	19	29.506	66	69	Do do.
	6	750.00	19	29.506	66	68	Do do.
	7	749.75	19	29.500	66	67	Do do.
	8	749.00	17	29.474	64	62	West-northwest wind.
	9	748.75	17	29.464	63	60	Do do.
Sunday, July 30, 1848.....	8 a. m.	742.75	17	29.236	63	62	South-southeast wind; cloudy.
	9	742.00	17	29.206	63	62	Rain.
	10	741.25	17	29.184	62	60	
	11	740.25	17	29.124	62	60	Stormy.
	12	739.50	17	29.104	63	60	
	1 p. m.	739.25	17	29.100	63	62	Rain ceased.
	2	739.00	17	29.090	63	64	Southwest wind; cloudy.
	3	739.00	17½	29.090	64	64	
	4	739.00	17	29.090	63	65	West wind.
	5	739.25	18	29.090	64	66	
	6	738.50	18	29.090	64	65	Sun shines.
	7	738.60	18	29.092	64	67	Fair.
	8	738 55	19	29.100	66	65	
	9	738.55	18	29 092	64	60	
Monday, July 31, 1848.....	8 a. m.	735.70	16	28 968	60	55	West wind; cloudy.
	9	735.70	16	28.968	61	55	Rain.
	10	735.50	16	28.992	60	53	
	11	735.70	16	28 996	60	54	Raining fast.
	12	735.75	16	29.016	60	54	Do.

Barometrical and thermometrical observations—Continued.

Day and date.	Hour.	Standard barometer.	Thermometer, attached—Cent.	Newman's iron cistern barometer.	Thermometer, attached—Fahr.	Temp. outside.	Remarks.
		Mil.	°	*Inches.*	°	°	
Monday, July 31, 1848.....	1 p. m.	736.50	16	29.028	60	54	
	2	736.60	16	29.040	60	54	
	3	737.50	16	29.054	60	54	
	4	737.50	15½	29.076	60	54	
	5	737.50	16	29.076	60	55	Rain ceased.
	6	738.25	16	.....	60	55	Do.
	7	739.75	16	29.111	60	55	
	8	739.75	15	29.124	60	55	
	9	739.75	15	29.164	60		
Tuesday, August 1, 1848.....	8 a. m.	742.00	15	29.264	58	55	West wind; fair.
	9	743.25	15	29.276	59	57	
	10	744.50	16	29.312	60	60	
	11	744.50	16	29.312	60	64	
	12	744.50	16	29.312	60	67	
	1 p. m.	744.50	16	29.312	61	68	
	2	744.50	17	29.312	62	74	
	3	744.50	18	29.312	64	74	
	4	744.50	18	29.312	64	77	
	5	744.50	19	29.312	66	77	
	6	744.50	19	29.312	68	75	
	7	744.50	20	29.312	68	75	Southwest wind.
	8	744.50	20	29.312	68	70	Do.
	9	744.50	20	29.312	68	66	Do.
Wednesday, August 2, 1848..	8 a. m.	746.00	18	29.388	66	65	Southwest wind; fair.
	9	746.00	19	29.404	66	66	
	10	746.30	20	29.408	68	72	
	11	746.60	21	29.410	68	76	
	12	746.75	22	29.416	71	80	South wind.
	1 p. m.	747.00	23	29.442	72	80	
	2	747.00	24	29.442	74	83	
	3	747.00	23	.....	74	86	Southeast wind.
	4	747.00	24	.....	74	83	

	7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	8	746.50	22	29.348	72	70	Do.
	9	746.50	22	29.348	70	67	Do.
Thursday, August 3, 1848..	8 a. m.	746.55	20	29.408	68	65	Cloudy; south wind.
	9	746.50	20	29.408	68	66	
	10	746.40	20	29.410	68	70	
	11	746.50	22	29.418	70	73	Fair.
	12	746 65	22	29.414	72	74	
	1 p. m.	746.90	23	29.412	73	76	
	2	746.65	23	29.412	72	80	South-southwest wind.
	3	746.75	23½	29.406	74	77	
	4	746.90	23	29.410	73	75	West wind.
	5	747.00	23	29.410	73	71	
	6	746.90	23	29.410	73	71	
	7	746.50	22	29.388	72	72	
	8	746.00	21	29.390	70	68	Southeast wind.
	9	746.00	20	29.390	68	68	
Friday, August 4, 1848.....	8 a. m.	745.00	20	29.340	68	66	North-northwest wind; cloudy.
	9	745.00	19½	29.340	68	66	
	10	745.00	20	29.350	68	67	
	11	745.00	20	29.364	68	67	Northwest wind; dense fog.
	12	745.00	17	29.380	64	58	12½; rain.
	1 p. m.	745.21	18	29.400	64	56	
	2	746.80	17	29.410	64	57	North wind.
	3	747.00	17	29.428	64	55	Northwest wind.
	4	747.00	17	29.444	64	57	
	5	747.15	17	29.442	64	57	
	6	747.25	17	29.450	64	58	Strong north wind.
	7	747.85	18	29.456	64	59	Fair.
	8	748.00	17	29.474	63	55	
	9	748.30	17	29.490	62	54	
Saturday, August 5, 1848....	8 a. m.	751.40	15	29.590	58	49	North wind; fair.
	9	751.50	15	29.602	60	51	
	10	752.25	16	29.616	63	55	
	11	752.25	16	29.616	60	57	
	12	752.25	16	29.616	60	60	Northwest wind.
	1 p. m.	752.00	16	29.606	61	61	
	2	751.90	16½	29.600	62	61	
	3	751.40	17	29.576	62	61	
	4	751.15	17½	29.566	64	67	

Barometrical and thermometrical observations—Continued.

Day and date.	Hour.	Standard barometer.	Thermometer attached—Cent.	Newman's iron cistern barometer.	Thermometer attached—Fahr.	Temp. outside.	Remarks.
		Mil.	°	*Inches.*	°	°	
Saturday, August 5, 1848...	5 p. m.	751.15	18	29.566	64	70	Calm.
	6	751.10	18	29.556	64	68	
	7	750.75	19	29.550	66	66	South-southeast wind.
	8	750.70	18½	29.550	65	64	
	9	750.50	17½	29.550	64	60	
Sunday, August 6, 1848.....	8 a. m.	749.40	18	29.506	64	68	South wind; fair.
	9	749.45	20	29.510	67	69	Southwest wind.
	10	749.40	20	29.510	68	70	
	11	749.50	21	29.516	70	71	West wind.
	12	749.30	22	29.508	71	79	Southwest wind; fresh.
	1 p. m.	749.30	22	29.492	72	82	
	2	748.80	22	29.476	72	83	South high wind.
	3	748.65	23	29.458	74	81	South-southwest wind.
	4	748.35	25	29.448	76	82	Very high wind.
	5	748.00	26	29.426	78	81	
	6	747.55	26	29.416	78	80	
	7	747.15	25	29.406	78	79	
	8	746.80	25	29.392	78	78	
	9	746.60	25	29.380	76	79	
Monday, August 7, 1848.....	8 a. m.	745.50	22	29.350	72	70	South-southwest wind; fair.
	9	745.50	23	29.352	73	73	Fresh breeze.
	10	745.00	24	29.328	74	76	
	11	745.00	26	29.328	78	81	
	12	745.00	27	29.330	80	83	Calm.
	1 p. m.	745.00	28½	29.346	82	88	South wind.
	2	745.00	28	29.346	80	79	West wind.
	3	745.00	28	29.328	80	88	South-southwest wind; fresh breeze.
	4	744.50	26	29.316	78	81	West wind.
	5	744.50	29	29.316	82	89	South high wind.
	6	744.50	29½	29.316	83	87	
	7	744.50	29	29.316	82	85	Southwest wind.
	8	744.25	28	29.316	82	82	Southwest high wind.
	9	744.25	27	29.316	80	80	South-southwest wind.

	12	743.55	25	29.262	76	79	Still.
	1 p. m.	743.25	27	29.264	80	85	
	2	743.25	27	29.260	80	84	
	3	743.25	27	29.260	79	83	South wind.
	4	743.00	28	29.260	81	87	West wind.
	5	743.15	27	29.294	80	77	West-northwest wind.
	6	743.15	27	29 300	80	81	
	7	744.20	27	29.312	80	79	
	8	744.25	26	29.328	78	77	West wind; strong breeze.
	9	746.00	25	29.376	76	76	
Wednesday, August 9, 1848..	8 a. m.	748.00	21	29.444	70	62	West wind; fair.
	9	748.25	21	29.454	70	65	West wind.
	10	748.40	23	29.466	72	70	South wind.
	11	748.30	24	29.464	74	75	Do.
	12	748.00	24	29.450	74	77	Do.
	1 p. m.	747.20	24	29.414	76	80	Southeast wind.
	2	746.60	24	29.382	74	76	Do.
	3	746.00	24	29.374	74	77	South wind.
	4	745.60	24½	29.350	75	76	South fresh breeze.
	5	744.75	24	29.316	74	75	South high wind.
	6	744.25	24	29.300	74	75	Southeast wind.
	7	743.80	24	29.286	76	70	South-southeast wind.
	8	743.55	23	29.286	73	69	South wind.
	9	743.00	23	29 246	73	74	South wind; cloudy.
Thursday, August 10, 1848..	8 a. m.	746.60	19	29.396	67	57	North-northwest wind; cloudy.
	9	748 00	19	29.446	66	58	West wind; little rain.
	10	748.00	18½	29.446	66	60	West wind.
	11	748 00	18	29.446	65	58	
	12	748.00	18	29.446	64	59	Southwest wind; cloudy.
	1 p. m.	748.00	18	29.446	65	61	Do do.
	2	748.00	18	29.446	65	61	Cloudy.
	3	748.30	18	29.464	64	64	Northwest wind; cloudy.
	4	748.30	18	29.468	64	63	Cloudy.
	5	748.30	18	29.468	64	64	West wind; cloudy.
	6	748.15	18	29.468	64	65	Northwest wind; cloudy.
	7	748.25	19½	29.468	66	63	Do fair.
	8	748.25	18	29.468	65	60	Do.
	9	748.25	17	29.472	62	60	Do. (Very little wind all day.)

Barometrical and thermometrical observations—Continued.

Day and date.	Hour.	Standard barometer.	Thermometer attached—Cent.	Newman's iron cistern barometer.	Thermometer attached—Fahr.	Temp. outside.	Remarks.
		Mil.	°	*Inches.*	°	°	
Friday, August 11, 1848.....	8 a. m.	749.45	15	29.500	60	52	West wind; fair.
	9	749.50	16	29.516	60	55	North wind.
	10	749.65	17	29.526	62	56	
	11	749.85	17	29.526	63	62	
	12	750.00	17	29.526	62	66	
	1 p. m.	750.00	18	29.538	63	69	
	2	750.00	18	29.540	64	67	
	3	750.00	18½	29.540	64	68	
	4	750.00	18	29.526	64	64	
	5	750.00	18½	29.524	66	63	
	6	749.85	19	29.516	66	63	North-northeast wind.
	7½	749.65	19	29.506	66	62	Do do.
	8	749.25	17	29.500	63	60	Do do.
Saturday, August 12, 1848...	8 a. m.	749.10	16	29.488	60	59	South wind; fair.
	9	749.10	17	29.490	62	61	Cloudy.
	10	749.25	18	29.500	64	64	
	11	749.35	18	29.510	64	69	Southeast wind; fair.
	12	749.35	19	29.510	64	72	
	1 p. m.	749.35	19½	29.510	66	75	
	2	749.35	21	29.510	70	73	Fresh breeze.
	3	749.15	21½	29.494	70	73	
	4	748.86	22	29.478	70	73	
	5	748.60	21	29.468	69	71	
	6	748.40	21	29.464	68	69	
	7	748.40	20	29.464	68	67	Calm.
	8	748.30	19	29.464	65	64	Southeast wind.
	9	748.10	17	29.464	63		
Sunday, August 13, 1848.....	8 a. m.	747.80	18	29.444	64	59	Northwest wind; dense fog.
	9	747.75	18	29.444	64	61	
	10	747.65	18	29.442	65	64	Rain.
	11	747.50	19	29.428	64	65	South wind; raining fast.
	12	747.35	19	29.416	65	66	Raining fast.

	5	746.40	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]-Northeast wind; raining fast.
	6	746.30	16½	29.376	63	58	Raining fast.
	7	746.50	16	29.386	62	58	Do.
	8	.....	.....	29.424	62	55	Northwest wind; raining fast.
Monday, August 14, 1848....	8	750.80	.....	29.538	56	48	North wind; cloudy.
	9	750.90	13	29.558	55	49	North wind; rain.
	10	751.75	15	29.586	62	49	North wind; windy.
	11	752.10	19½	29.610	72	51	North wind; rain ceased.
	12	752.65	19	29.620	68	49	North wind.
	1 p. m.	752.75	17	29.642	68	51	Do.
	2	753.00	17	29.650	66	52	Do.
	3	754.00	19	29.680	68	53	Do.
	4	754.00	18½	29.680	67	53	North wind; sun shining.
	5	754.00	17	29.688	64	53	North wind; cloudy.
	6	754.25	19	29.694	68	51	Do do.
	7	754.35	17½	29.698	66	51	Do do.
	8	754.35	16½	29.698	66	51	Do do.
Tuesday, August 15, 1848....	8 a. m.	755.45	13	29.744	58	46	Northeast wind; cloudy.
	9	755.70	13	29.746	58	46	Northeast wind.
	10	756.40	16	29.788	64	52	Northeast wind; sun shines.
	11	756.30	15	29.778	62	53	Northeast wind; clouds.
	12	756.15	14	29.774	60	55	Do do.
	1 p. m.	756.00	16½	29.764	62	59	Do do.
	2	756.00	16½	29.764	63	56	Do do.
	3	755.80	16	29.752	62	56	Northeast wind; fair.
	4	755.45	16½	29.746	63	56	Do do.
	5	755.15	20	29.734	63	54	Do do.
	6	755.00	16	29.714	63	53	Do do.
	7	754.80	14	29.694	60	51	Do do.
	8	754.30	14	29.688	59	50	Do do.
Wednesday, August 16, 1848.	8 a. m.	752.90	12	29.644	56	47	Do do.
	9	752.95	14	29.644	57	51	Do do.
	10	753.00	15	29.644	60	54	Northwest wind; fair.
	11	752.85	15½	29.654	62	56	Do do.
	12	753.00	15	29.662	60	58	Do do.
	1 p. m.	752.90	15	29.654	58	60	Do do.
	2	752.90	15½	29.654	60	63	Do do.
	3	752.90	16	29.654	60	64	Do do.

Barometrical and thermometrical observations—Continued.

Day and date.	Hour.	Standard barometer.	Thermometer, attached—Cent.	Newman's iron cistern barometer.	Thermometer, attached—Fahr.	Temp. outside.	Remarks.
		Mil.	°	*Inches.*	°	°	
Wednesday, August 16, 1848.	4 p. m.	752.80	16	29.634	62	63	Northwest wind; fair.
	5	752.65	16½	29.620	62	62	Do do.
	6	752.50	16½	29.616	62	61	Do do.
	7	752.40	17	29.600	64	59	Do do.
	8	752.25	16	29.600	60	57	Do do.
Thursday, August 17, 1848...	8 a. m.	752.35	16½	29.608	63	51	Northwest wind; fair.
	9	752.35	16	29.606	62	58	Do. cloudy.
	10	752.20	16	29.604	61	58	Do.
	11	752.20	17	29.604	64	59	Do.
	12	752.25	18	29.606	65	61	Do. fair.
	1 p. m.	752.40	18	29.604	66	63	Do.
	2	752.40	18	29.604	64	68	Do.
	3	752 00	18	29.604	65	67	Do.
	4	752.00	18½	29.596	66	65	Do.
	5	751.80	19	29.586	66	63	Do.
	6	751.75	19	29.588	66	60	Do.
	7	751.65	18½	29.570	66	60	Do.
	8	751.50	17½	29.570	66	58	Do.
Friday, August 18, 1848.....	8 a. m.	751.80	17½	29.590	65	52	East wind; fair.
	9	752.10	18	29.602	65	55	
	10	752.10	18	29.602	66	57	North wind.
	11	752.75	18	29.602	65	60	
	12	752.45	18	29.602	65	64	
	1 p. m.	752.25	18	29.590	65	65	
	2	752.00	18½	29.568	66	65	
	3	751.55	19	29.550	66	65	East wind.
	4	751.25	19	29.538	65	65	
	5	751.25	19½	29.538	64	64	
	6	750.85	18	29.526	64	64	South wind.
Saturday, August 19, 1848....	8 a. m.	748.80	18	29.450	64	60	South wind; fair.
	9	748.80	19	29.450	65	61	Do.
	10	748.85	19½	29.450	66	64	Do.

	6	745.90	22	29.354	70	73	Do.
	7	745.90	21½	29.352	70	70	Do.
	8	745.90	21½	29.346	68	68	Do.
Sunday, August 20, 1848.....	8 a. m.	744.95	19	29.344	65	63	Do cloudy.
	9	745.00	19	29.348	66	64	Do do.
	10	745.25	19	29.348	66	66	Do do.
	11	745.75	23	29.370	64	68	Do thin clouds.
	12	746.25	27	29.398	82	73	Do do.
	1 p. m.	746.55	22	29.394	73	72	Do do.
	2	746.45	24½	29.388	78	71	Do do.
	3	746.50	21	29.388	70	70	Do do.
	4	746.55	22½	29.392	72	67	Do do.
	5	746.60	22	29.394	72	63	Do rain.
	6	746.55	20	29.394	69	64	Do do.
	7	746.50	20	29.394	69	62	Do rain ceased.
	8	746.45	18½	29.382	67	58	Do do.
Monday, August 21, 1848....	8 a. m.	745.75	18	29.374	65	60	Southeast wind; cloudy.
	9	746 00	20	29.386	70	62	Do do.
	10	746.25	20	29.388	70	62	Southeast wind; rain.
	11	746.30	20½	29.394	70	64	Southeast wind; rain ceased.
	12	746.25	20	29.390	69	62	Do do.
	1 p. m.	746.25	20½	29.378	70	67	Southeast wind; cloudy.
	2½	746.25	20½	29.374	69	69	Do do.
	3	746.25	20½	29.376	70	66	Southeast wind; rain.
	4	746.30	20½	29.368	69	66	Do do.
	5	746.25	21	29.364	69	68	Southeast wind; fair.
	6	746.30	21	29.364	69	68	Southeast wind; cloudy.
	7	746.50	21	29.370	70	67	Do do.
	8	746.50	20½	29.384	68	66	Do do.
Tuesday, August 22, 1848...	8 a. m.	746.80	19	29.400	66	61	Southeast wind; rain.
	9	747.00	19	29.400	66	62	Do do.
	10	747.00	18	29.396	66	61	Do do.
	11	747.00	18½	29.394	66	61	Do do.
	12	746.90	19	29.392	66	58	Do do.
	1 p. m.	746.50	21	29.376	70	59	East wind; rain.

Barometrical and thermometrical observations—Continued.

Day and date.	Hour.	Standard barometer.	Thermometer, attached—Cent.	Newman's iron cistern barometer.	Thermometer, attached—Fahr.	Temp. outside.	Remarks.
		Mil.	°	*Inches.*	°	°	
Tuesday, August 22, 1848...	2 p. m.	746.35	19	29.376	69	59	East wind; heavy rain.
	3	746.25	21½	29.364	72	59	Do do.
	4	746.30	22	29.362	75	59	Do do.
	5	746.10	23	29.350	75	60	Do do.
	6	745.80	22	29.348	74	59	Do do.
	7	745.50	21	29.339	73	59	Southeast wind; heavy rain.
	8	745.50	22	29.330	72	58	Do do.
Wednesday, August 23, 1848.	8 a. m.	745.75	18½	29.364	66	58	Southeast wind; cloudy.
	9	745.90	18	29.364	64	62	Do do.
	10	745.90	18	29.366	65	63	Do do.
	11	746.00	19	29.378	66	64	Do do.
	12	746.60	19	29.378	66	67	Do do.
	1 p. m.	746.00	19	29.376	66	66	Do do.
	2	746.15	19	29.376	66	69	Do do.
	3	746.15	20	29.376	67	67	Southeast wind; slight shower.
	4	746.50	20	29.376	67	66	Southeast wind; cloudy.
	5	746.50	19½	29.376	68	68	South wind; cloudy.
	6	746.55	21	29.376	70	68	South wind; fair.
	7	746.60	21	29.376	70	65	Do do.
	8	746.60	20	29.376	68	64	Do do.
Thursday, August 24, 1848..	8 a. m.	746.85	18	29.416	65	62	South wind; cloudy.
	9	746.75	18.5	29.426	64	63	South wind; calm.
	10	748.30	19	29.442	66	67	Do do.
	11	748.35	20	29.442	67	67	South wind; shower.
	12	748.40	20	29.444	67	72	South wind; cloudy.
	1 p. m.	748.40	20	29.444	68	72	Do do.
	2	748.40	21	29.450	69	77	Southeast wind; fair.
	3	748.30	21.5	29.448	70	72	Do do.

	4	749.55	26	29.492	75	79	Do do.
	3	749.55	24	29.478	76	79	Southeast wind; calm.
	4	749.25	25	29.486	75	78	Do do.
	5	749.40	28	29.488	76	77	Do do.
	6	749.15	23	29.474	74	74	Do do.
	7	748.75	23	29.474	73	72	Do do.
	8	748.80	23	29.462	73	69	Southeast wind; fresh breeze.
Saturday, August 26, 1848...	8 a. m.	749.35	22	29.516	71	68	South wind; fair.
	9	750.15	23	29.552	72	70	South wind; calm.
	10	750.75	22	29.584	72	68	Southwest wind; calm.
	11	750.70	22	29.586	71	71	West wind; calm.
	12	750.80	22	29.592	72	74	Northwest wind; calm.
	1 p. m.	750.60	22	29.576	73	77	North wind; calm.
	2	750.65	22	29.576	72	77	Do do.
	3	750.50	22½	29 556	72	75	Southeast wind, cloudy.
	4	750.35	23	29.552	73	77	Do do.
	5	750.25	23½	29.550	74	76	South-southeast wind; cloudy.
	6	750.25	24	29.550	74	75	Cloudy.
	7	749.90	22	29.548	72	68	Northwest wind; cloudy.
	8	749.60	20	29.520	69	64	Do do.
Sunday, August 27, 1848....	8 a. m	.....	.....	.....	.....	.....	Cloudy.
	9	747.10	21½	29.462	73	62	North-northeast wind; rain.
	10	747.20	25	29.476	82	63	East wind; rain.
	11	747.00	24½	29.458	78	69	East wind; cloudy.
	12	746 60	23	29.432	76	69	South-southeast wind; cloudy.
	1 p. m.	746.30	22	29.422	73	71	South-southeast wind; fair.
	2	746.00	23	29.420	73	71	East wind; fair.
	3	745.90	23	29.400	74	68	Fair.
	4	745.80	23½	29.396	73	65	East-northeast wind; fair
	5	745.00	22	29.394	72	64	East-northeast wind; cloudy.
	6	745.00	20	29.394	70	62	Do do.
	7	744.95	19½	29.394	68	61	Do do.
	8	744.95	19	29.394	68	60	Do do.
Monday, August 28, 1848....	8 a. m.	745.15	18½	29.444	65	58	West wind; fair.
	9	745.35	18½	29.432	66	60	West wind; calm.

Barometrical and thermometrical observations—Continued.

Day and date.	Hour.	Standard barometer.	Thermometer attached—Cent.	Newman's iron cistern barometer.	Thermometer attached—Fahr.	Temp. outside.	Remarks.
		Mil.	°	*Inches.*	°	°	
Monday, August 28, 1848.....	10 a. m.	745.75	18½	29.436	66	60	West wind; calm.
	11	745.70	18	29.450	65	59	West wind; fog.
	12	745.85	18	29.450	64	63	West wind; fair.
	1 p. m.	746.00	19	29.450	66	66	Do.
	2	746.00	19	29.450	66	66	Do.
	3	745.85	19	29.450	66	70	West-northwest wind; fair.
	4	745.85	20	29.444	67	69	Do do.
	5	745.65	20	29.444	68	67	West wind; fair.
	6	745.75	20	29.442	68	66	Do.
	7	745.75	21	29.440	70	65	Do.
	8	745.75	.....	29.440	68	63	Do.
Tuesday, August 29, 1848....	8 a. m.	746.00	19	29.442	66	63	Fair.
	9	746.00	20	29.442	68	70	Southwest wind; calm.
	10	746.00	21	29.438	70	70	Do do.
	11	746.00	21	29.428	70	71	Do do.
	12	746.00	21½	29.428	70	75	Do do.
	1 p. m.	746.00	22½	29.424	72	77	Do do.
	2	745.85	23	29.424	73	82	Do do.
	3	745.75	23½	29.410	73	80	North wind; calm.
	4	745.80	24	29.396	74	79	Do.
	5	745.00	24	29.386	74	77	Do.
	6	745.00	23½	29.386	74	76	Do.
	7	744.75	23	29.368	74	74	Do.
	8	744.85	23	29.370	73	72	Do.
Wednesday, August 30, 1848.	8 a. m.	743.80	21	29.316	70	67	South wind; fair; calm.
	9	743.80	23	29.314	70	70	Do do.
	10	743.70	23½	29.306	72	72	South wind; fresh.
	11	743.35	23½	29.300	73	73	Southeast wind; fresh.
	12	743.30	25	29.300	76	77	Do do.
	1 p. m	743.10	26	29.300	78	80	Do do.

	6	740.00	[illegible]	[illegible]			Do do.
	7	738.40	23	29.126	73	71	
	8	.....	.....	.....	.....	.....	Wind shifted to west in night; heavy rain and high wind.
Thursday, August 31, 1848..	8 a. m.	728.50	20	28.764	68	59	Southwest wind; cloudy.
	9	728.30	19	28.754	68	57	Southwest wind.
	10	727.75	20	28.748	68	58	Southwest wind; rain.
	11	727.85	20	29.762	68	57	Do do.
	12	728.20	20	28.764	68	60	Southwest wind; cloudy.
	1 p. m.	728.15	19	28.756	67	59	Do do.
	2	727.90	19	28.744	66	60	Do do.
	3	728.00	18½	28.738	66	60	Do do.
	4	728.00	18½	28.738	66	58	Southwest wind; rain.
	5	727.90	18	28.736	65	59	Do do.
	6	727.90	18	28.740	65	57	Northwest wind; rain.
	7	729.00	17	28.786	64	55	Do do.
	8	730.25	18	28.846	66	54	Do do.
Friday, September 1, 1848...	8 a. m.	740.70	15	29.218	60	54	West wind; cloudy.
	9	742.00	19	29.282	69	55	Northwest wind; fog.
	10	743.80	20	29.328	71	56	Do do.
	11	743.70	20	29.356	70	58	Do do.
	12	743.80	19	29.356	68	59	Do do.
	1 p m.	743.90	19	29.364	67	61	Do do.
	2	744.35	19	29.386	66	62	Do do.
	3	745.20	19	29.404	66	63	Northwest wind; fair.
	4	745.35	19½	29.414	67	67	Do do.
	5	745.50	19½	29.434	67	65	Do do.
	6	746.00	20	29.448	66	64	Do do.
	7	746.25	18	29.450	65	59	Do do.
	8	746.50	17	29.474	64	57	Do do.
Saturday, September 2, 1848.	8 a. m.	747.85	15½	29.514	62	57	South wind; fair, high wind.
	9	747.90	16½	29.500	63	57	Do do.
	10	748.00	17½	29.500	64	61	Do do.
	11	747.75	19	29.488	66	65	South wind; cloudy, calm.
	12	747.50	19	29.468	66	67	Do do.
	1 p. m.	747.00	19	29.466	66	68	Southeast wind; do.
	2	747.00	20	29.460	68	67	Do do.
	3	747.00	20	29.456	68	68	Do do.
	4	746.50	20	29.438	69	70	South wind; thunder cloud west.
	5	746.30	20	29.418	68	68	Do do.

Barometrical and thermometrical observations—Continued.

Day and date.	Hour.	Standard barometer.	Thermometer, attached—Cent.	Newman's iron cistern barometer.	Thermometer, attached—Fahr.	Temp. outside.	Remarks.
		Mil.	°	*Inches.*	°	°	
Saturday, September 2, 1848.	6 p. m.	746.30	19	29.438	67	64	South wind; thunder storm.
	7	746.25	19	29.428	66	66	South wind; clear.
Sunday, September 3, 1848...	8 a. m.	746.55	16½	29.448	62	60	Southeast wind; cloudy.
	9	746.55	17	29.438	62	62	Southeast wind; rain.
	10	746.55	18	29.438	65	61	Southeast wind; high.
	11	745.55	21	29.392	70	62	South-southeast wind; high.
	12	744.60	19½	29.328	66	64	Rain ceased.
	1 p. m.	744.25	21	29.358	72	65	Calm.
	2	744.25	21	29.378	70	66	South-southwest wind; calm.
	3	744.00	20	29.350	68	67	South wind; rain.
	4	744.00	21	29.338	68	67	South wind; high.
	5	744.00	20	29.328	68	66	Do do.
	6	743.00	19½	29.300	67	65	South wind; calm.
	7	743.00	20	29.300	68	65	South wind; fair.
	8	742.50	19	29.268	66	65	South wind; fair, high.

Barometrical and thermometrical observations—Continued.

Day and date.	Hour.	Standard barometer.	Thermometer, attached—Cent.	Newman's barometer.	Thermometer, attached—Fahr.	Thermom. detached—Fahr.	Remarks.
		Mil.	°	*Inches.*	°	°	
Monday, September 4, 1848..	8 a. m.	738.00	21	29.116	68	69	Southwest wind; cloudy, calm.
	9	738.25	21	29.150	69	68	Cloudy, fresh wind.
	10	738.20	21	29.150	70	70	Do do.
	11	738.20	21	29.150	70	72	Do do.
	12	738.50	22	29.168	70	73	West-southwest wind; cloudy, high wind.
	1 p. m.	739.35	21½	29.186	70	72	West wind; cloudy, high wind.
	2	740.00	21	29.214	70	71	Do do.
	3	740.80	21	29.196	70	71	Southwest wind; cloudy, high wind.
	4	741.35	21	29.266	70	70	Cloudy, high wind.
	5	742.10	21½	29.294	70	68	Do do.
	6	742.50	21	29.314	70	66	Do do.
	7	743.25	20	29.340	69	63	Do do.
	8	744.00	20	29.364	68	60	Do do.
Tuesday, September 5, 1848..	8 a. m.	748.25	16	29.526	61	52	Southwest wind; fair.
	9	748.50	16½	29.536	62	54	Southwest wind; fair, fresh breeze.
	10	749.15	17	29.564	62	55	Do do.
	11	749.35	16	29.570	62	57	Fair, fresh breeze.
	12	750.00	16½	29.578	60	59	Fair, high wind.
	1 p. m.	750.00	16½	29.586	61	60	West wind; fair, high wind.
	2	750.00	16	29.580	61	62	Fair, high wind.
	3	750.20	17	29.588	62	65	Do.
	4½	750.25	18	29 594	64	64	West southwest wind; fair, fresh breeze.
	5	750.90	18	29 600	64	63	Fair, fresh breeze.
	6	750.90	18	29.606	65	62	Do.
	7	750.90	17½	29.608	64	60	Do.
	8	750.95	17	29 616	62	57	Do.
Wednesday, Sept. 6, 1848....	8 a. m.	754.00	15	29.714	59	55	Southwest wind; fair, calm.
	9	754.15	16	29.724	60	57	Do do.
	10	754.25	17	29.726	64	59	South wind; fair, calm.
	11	754.00	18	29.718	65	63	Do do.
	12	753.80	18	29.714	65	66	South wind; fair, fresh breeze.
	1 p. m.	753.55	18½	29.700	66	68	Do do.

Barometrical and thermometrical observations—Continued.

Day and date.	Hour.	Standard barometer.	Thermometer, attached—Cent.	Newman's barometer.	Thermometer, attached—Fahr.	Thermom. detached—Fahr.	Remarks.
		Mil	°	*Inches.*	°	°	
Wednesday, Sept. 6, 1848....	2 p. m.	.....	.....	.....	.....	.....	South wind; fair, fresh breeze.
	3	.....	.....	.....	.....	.....	Do do.
	4	.....	.....	.....	.....	.....	Southeast wind; fair, fresh breeze.
	5	751.55	19	29.622	66	65	Do do.
	6	751.00	18	29 606	65	65	Do do.
	7	750.75	18	29.594	64	62	Do do.
	8	750.65	17	29.586	62	60	Do. do.
Thursday, September 7, 1848.	8 a. m.	748.25	16½	29.478	62	59	South wind; fair, calm.
	9	748.15	17	29.474	63	61	Do do.
	10	748.00	17½	29.476	64	67	West wind; fair, fresh breeze.
	11	748.00	18	29.476	64	67	Do do.
	12	748.00	19	29.476	65	69	Do do.
	1 p. m.	748 00	19½	29.476	66	72	Do do.
	2	748.00	19½	29.476	66	69	Do do.
	3	748.00	20	29.484	67	74	Do do.
	4	748.00	20½	29.484	68	72	Do do.
	5	748.00	20½	29.500	69	70	Do do.
	6	748.00	20½	29 500	69	68	West wind; fair, calm.
	7	748.00	20	29 514	68	65	Do do.
	8	748.30	19	29.524	66	62	Do do.
Friday, September 8, 1848....	8	753.70	16½	29.738	63	49	North wind; cloudy, high wind.
	9	754.30	16	29.750	62	49	Do do.
	10	754.75	17	29.766	66	51	Do do; temp. water on lake shore 58°.
	11	755.00	17½	29.764	65	51	
	12	755.00	17	29.762	63	53	Do do; heavy swell on lake.
	1 p. m.	754.55	16½	29 750	62	52	Do fair, do.
	2	754.50	17	29.750	62	57	Northwest wind; fair, do.
	3	754.00	15½	29.734	60	54	Do do.
	4	754.00	15	29 738	60	54	Do do.
	5	754 00	16	29.716	61	54	Do do.
	6	753.60	16½	29.694	61	52	Do fair, calm.
	7	753.40	16½	29.694	62	50	West wind; fair, calm.

	8	753.25	16½	29.694	61	45	Do do.
Saturday, September 9, 1848..	8 a. m.	750.50	12	29 576	54	46	Southwest wind, cloudy, calm.
	9	750.25	12	29 560	54	50	Do. do.
	10	750.00	12½	29.550	54	51	Do. do.
	11	749 50	12½	29.538	54	53	West wind; cloudy, calm.
	12	749.50	13½	29.538	57	53	Do. do.
	1 p. m.	749.00	13½	29.506	57	54	Do. do.
	2	748.50	13	29.500	56	53	West-southwest wind; rain, calm.
	3	748.20	13	29.478	56	51	Do do.
	4	747.75	13	29.464	55	50	Do do.
	5	747.60	12½	29.450	55	50	Do do.
	6	747.00	12½	29.444	54	49	Do do.
	7	746.65	12	29.414	55	48	Do do.
	8	746.30	12	29.400	54	48	West-southwest wind; rain, calm. (Rain most of the night.)
Sunday, September 10, 1848..	8 a. m.	742.85	11½	29.282	54	46	North wind; cloudy; calm.
	9	743.00	12	29.298	54	46	Do fair; do.
	10	743.15	12	29.316	54	49	Northwest wind; temperature of water on shore, 57°.
	11	743.30	12½	29.316	55	50	Northwest wind.
	12	743.35	12½	29 316	54	53	Do.
	1 p. m.	743.15	13	29.324	55	55	Do cloudy; calm.
	2	743.20	13	29.340	56	55	Do fair; do.
	3	743.25	13	29.340	56	55	Do do do.
	4	743.45	13½	29.342	56	58	Do do do.
	5	743.50	13½	29.350	56	56	Do cloudy; do.
	6	743.80	13½	29.364	56	55	West wind; do do.
	7	744.00	13½	29.368	56	53	Do do do.
Monday, September 11, 1848.	8 a. m.	748.25	11	29.532	52	46	Northwest wind; do do.
	9	748.85	11	29.550	53	46	Do fair; do.
	10	749.25	11	29.566	53	48	Do do do.
	11	749.50	11	29.584	53	50	Do do do.
	12	749.75	11	29.586	52	51	Do do do.
	1 p. m.	749.75	11	29.588	52	55	Do do do.
	2	749.85	11½	29.584	53	56	North-northwest wind; fair; calm.
	3	749.85	11½	29.592	53	58	Do do do.
	4	749 80	12	29.592	54	58	Do do do.
	5	750 00	12½	29.588	54	57	Do do do.
	6	749 75	12½	29.580	54	55	Do cloudy; calm.
	7	750.45	12½	29.588	54	54	West wind; do do.
	8	750.30	12½	29.590	54	52	Do do do.

Barometrical and thermometrical observations—Continued.

Day and date.	Hour.	Standard barometer.	Thermometer attached—Cent.	Newman's barometer.	Thermometer attached—Fahr.	Thermometer detached—Fahr.	Remarks.
		Mil.	°	*Inches*	°	°	
Tuesday, September 12, 1848.	8 a. m.	754.70	11½	29.750	53	44	Northwest wind; fair; calm.
	9	754.80	11½	29.778	53	45	North wind; do do.
	10	755.50	12	29 794	54	47	Do do do.
	11	756.00	12	29.800	54	49	Do do do.
	12	756.20	12	29.800	54	51	Do do do.
	1 p. m.	756.15	12½	29.800	55	54	Northwest wind; do do.
	2	756.00	12½	29.800	55	56	Do do do.
	3	755.75	12½	29.796	54	58	Do do do.
	4	755.50	13	29.776	54	56	Do do do.
	5	755.30	13	29.764	55	54	Do do do.
	6	755.15	13	29.750	56	51	Do do do.
	7	754.60	13	29.742	55	48	Do do do.
	8	754.60	12½	29.742	52	47	Do do do.; heavy frost at night.
Wednesday, Sept. 13, 1848...	8 a. m.	754.00	10	29.728	52	40	Southeast wind; fair; calm.
	9	753.80	11	29.714	52	48	Do do.
	10	753.20	11½	29.688	52	52	Do do.
	11	753.00	12	29.678	53	52	Do do. fresh breeze.
	12	752.50	13	29.656	56	58	Do do do.
	1 p. m	752.20	13	29.650	56	60	Do do do.
	2	751.50	13½	29.626	56	60	Do do do.
	3	750.75	14	29.600	57	62	Do cloudy; do.
	4	750.20	14	29.574	57	57	East-southeast wind; cloudy; fresh breeze.
	5	749.70	14	29.550	57	56	Do do do.
	6	749.50	14	29.544	57	55	Do do do.
	7	740.70	13½	29.500	56	53	Do do do.
	8	748.05	13½	29.464	56	53	Do do high wind rain at night.
Thursday, September 14, 1848	8 a. m.	740.25	13	29.182	56	49	East wind; rain.
	9	740.20	13	29.178	56	49	Do.
	10	740.25	13	29.178	56	49	Do.
	11						

	3	740.50	13	29.218	55	50	Do do.
	4	740.50	13	29.238	56	51	Do do.
	5	740.75	13	29.256	56	51	North wind; rain.
	6	741.00	13	29.274	56	50	West wind; fair.
	7	741.40	13	29.288	55	48	Do.
	8	741.55	13	29.436	53	42	Northwest wind; fair; calm.
Friday, September 15, 1848..	8 a. m	745.90	11	29.444	54	47	Do do.
	9	746.25	12	29.444	54	51	Do do.
	10	746.35	12	29.446	54	53	Do do.
	11	746.35	12	29.446	54	57	Northwest wind; fair; fresh wind.
	12	746.40	12½	29.450	56	56	Do do do.
	1 p. m.	746.25	13	29.442	58	56	Do do do.
	2	746.15	13½	29.418	57	52	Cloudy; calm.
	3	746.00	13	29.396	57	60	Fair; calm.
	4	745.70	13	29.388	57	58	Do.
	5	745.30	14	29.366	57	57	Do.
	6	745.00	14	29.350	56	56	South wind; fair; calm.
	7	744.75	14	29.328	57	55	South wind; fair.
	8	744.20	14	29.138	56	53	South wind; rain; calm.
Saturday, September 16, 1848.	8 a. m.	737.60	13	29.087	56	54	Do do.
	9	737.10	13	29.050	58	55	Do do.
	10	736.45	13½	29.028	57	57	Southwest wind; rain; calm.
	11	736.20	13½	29.018	56	55	Southwest wind; cloudy; calm.
	12	736.00	14	29.000	57	57	Do do.
	1 p. m	735.45	14	29.000	57	54	West wind; cloudy; calm.
	2	735.35	14	28.988	57	57	Do do.
	3	735.00	14	28.978	57	56	Do do.
	4	735.00	14	28.984	58	53	West wind; rain; calm.
	5	734.75	14	28.989	57	54	Do do.
	6	734.75	14	29.000	58	51	Do do.
	7	735.00	14	29.000	58	51	Do do.
	8	735.00	14	29.084	56	49	Northwest wind; calm; cloudy.
Sunday, September 17, 1848..	8 a. m.	737.00	13	29.084	56	50	Do do.
	9	737.00	13	29.100	56	51	Do do.
	10	737.20	13	29.124	56	52	Do do.
	11	737.65	13	29.136	56	55	Northwest wind; fresh wind; fair.
	12	738.15	14	29.150	56	57	Do do.
	1 p. m.	738.30	14	29.150	57	57	Do do.
	2	738.50	14½				

Barometrical and thermometrical observations—Continued.

Day and date.	Hour.	Standard barometer.	Thermometer, attached—Cent.	Newman's barometer.	Thermometer, attached—Fahr.	Thermometer, detached—Fahr.	Remarks.
		Mil.	°	*Inches.*	°	°	
Sunday, September 17, 1848.	3 p. m.	738.75	15	29.156	58	59	Northwest wind; fresh; fair.
	4	739.00	14½	29.156	58	57	Northwest wind; fresh; cloudy. Water on shore 54° F.
	5	739.25	14½	29.176	58	56	Northwest wind; fair.
	6	739.75	14½	29.198	58	55	West-northwest wind; fair; calm.
	7	740.00	14½	29.200	59	53	West wind; fair; calm.
	8	740.45	14½	29.228	58	52	Do do.
Monday, September 18, 1848.	8 a. m.	741.65	13	29.278	56	50	Northwest wind; cloudy; calm.
	9	741.85	13	29.278	56	52	Do do do.
	10	741.90	13½	29.278	56	54	Do do do.
	11	741.90	13½	29.268	56	54	Northwest wind; rain; calm.
	12	742.00	14	29.274	57	53	Do do.
	1 p. m.	741.75	13½	29.270	56	52	West wind; rain; calm.
	2	741.75	13½	29.260	56	53	Do do.
	3	741.70	13½	29.260	56	52	Do do.
	4	741.75	13½	29.254	56	50	Do do.
	5	741.75	13½	29.254	56	51	Do do.
	6	741.75	13½	29.256	56	52	Southwest wind; cloudy; calm.
	7	741.75	13½	29.258	56	50	Do do do.
	8	741.75	13½	29.260	56	49	Do do do.
Tuesday, September 19, 1848.	8 a. m.	741.25	12½	29.214	54	49	Northwest wind; cloudy; calm.
	9	741.25	12½	29.214	54	49	Northwest wind; cloudy; calm; water on shore 52°.
	10	741.25	12½	29.218	54	48	West wind; rain; calm.
	11	741.25	12½	29.218	54	49	Northwest wind; rain; calm.
	12	741.10	12½	29.218	55	48	North wind; cloudy; calm.
	1 p. m.	741.00	12½	29.218	55	49	North wind; rain; calm.
	2	741.00	12½	29.218	55	48	Northeast wind; rain; calm.
	3	741.00	12½	29.218	55	47	Northeast wind; cloudy; high wind; water on shore 52°.
	4	741.00	12½	29.218	54	45	North wind; rain; high wind.
	5	741.00	12	29.200	[illegible]	[illegible]	[illegible]

	6	741.00	12	29.228	54	45	North wind; cloudy; high wind.
	7	741.00	12	29.238	53	45	Do do do.
	8	741.10	11½	29.250	52	45	Do do do.
Wednesday, Sept. 20, 1848...	8 a. m.	741.50	9	29.264	48	40	Northwest wind; cloudy; windy.
	9	741.75	9	29.280	48	41	Do do do.
	10	741.90	9	29.284	48	41	Do do do.
	11	742.45	9	29.300	48	42	Do do do.
	12	742.75	9	29.314	48	42	Do do do.
	1 p. m.	742.75	9	29.318	48	45	Do do do.
	2	742.85	9	29.318	48	45	Do do do.
	3	743.00	9	29.328	48	47	Do do do.
	4	743.00	9	29.328	48	46	Northwest wind; fair; windy.
	5	743.30	9	29.342	48	47	Northwest wind; fair; windy; water on lake shore 53°.
	6	743.60	9	29.350	48	43	Northwest wind; fair; windy.
	7	744.25	9	29.366	48	43	Northwest wind; fair; calm.
	8	744.55	9	29.380	48	42	Do do.
Thursday, Sept. 21, 1848....	8 a. m.	750.10	8	29.588	46	43	Northwest wind; fair; windy.
	9½	751.00	8½	29.616	47	43	Do do.
	10	751.90	9	29.638	47	44	Northwest wind; cloudy; water on shore 52½°.
	11	752.10	9½	29.654	48	45	Northwest wind; fair; windy.
	12	752.35	9	29.672	48	46	Do do.
	1 p. m.	752.50	10	29.680	51	49	Do do.
	2	752.50	10	29.670	50	52	Do do.
	3	752.50	10	29.670	50	55	West-northwest wind; fair; calm.
	4	752.35	9½	29.656	50	52	Do do do.
	5	752.35	11	29.650	52	51	West wind; fair; calm.
	6	752.35	11	29.652	52	48	Do do.
	7	752.35	10	29.654	52	45	Do do.
	8	752.10	10	29.650	50	42	Southwest wind; fair; calm.
Friday, September 22, 1848..	8 a. m.	753.75	9	29.718	48	41	Southwest wind; fair; calm.
	9	753.80	10	29.728	50	45	Do do.
	10	754.00	10	29.728	50	50	Do do.
	11	754.00	10	29.728	50	52	Do do.
	12	754.00	11	29.716	52	53	West-northwest wind; fair; calm.
	1 p. m.	753.80	11	29.706	52	51	Do do.
	2	753.45	11	29.700	52	56	West-northwest wind; fair; windy.
	3	753.00	11	29.680	52	53	Do do.
	4	752.80	12	29.670	55	55	Northeast wind; fair; calm.
	5	752.35	12	29.660	54	53	East-northeast wind; cloudy; calm.
	6	752.25	12½	29.654	54	52	East-northeast wind; fair; calm.
	7	752.25	12	29.650	54	51	Northwest wind; fair; calm.

Barometrical and thermometrical observations—Continued.

Day and date.	Hour.	Standard barometer.	Thermometer, attached—Cent.	Newman's barometer.	Thermometer, attached—Fahr.	Thermometer, detached—Fahr.	Remarks.
		Mil.	°	*Inches.*	°	°	
Friday, September 22, 1848..	8 p. m.	751.75	12	29.638	52	48	Southeast wind; fair; calm.
Saturday, September 23, 1848	8 a. m.	.....	11	.....	52	45	Southwest wind.
	9	.....	11	.....	52	52	Do.
	10	.....	11	.....	52	54	West wind.
	11	.....	12	.....	55	57	Do.
	12	.....	12½	.....	57	59	Do.
	1 p. m.	.....	12½	.....	56	60	Do.
	2	.....	14	.....	58	59	Do.
	3	.....	13	.....	56	60	Do.
	4	.....	13	.....	56	54	Do.
	5	.....	13	.....	56	54	Do.
	6	.....	12½	.....	55	52	Do.
	7	.....	12	.....	54	50	North wind.
	8	.....	12	.....	54	49	

Meteorological register—Mean monthly results.

Year and month.	Thermometer detached.					Wet bulb.		Remarks.		
	Sunrise.	9 a. m.	3 p. m.	9 p. m.	Daily mean.	Sunrise.	3 p. m.			
1844.	°	°	°	°	°	°	°			
June	50.80	58.04	65.92	52.35	58.53	48 78	54.39	Observations by Assistant Surgeon C. E. Isaacs.		
July	56.77	64.38	72.03	60.03	64.96	55.22	60.77	Do	do	do.
August	57.70	64.19	69.80	60.70	63.90	56.67	61.48	Do	do	do.
September	50.43	58.30	62.40	52.16	56.50	49.56	56.56	Do	do	do.
October	37.16	44.48	46.51	38.41	42.22	36.77	42 64	Do	do	do.
November	28.20	30.73	31.30	27.93	30.40	27.40	28.46	Do	do	do.
December	20.93	22.45	25.09	22.22	23.06	19.33	23.54	Do	do	do.
1845.										
January	19.96	21.70	23.61	20.32	21.77	19.48	22.80	Do	do	do.
February	20.96	23 03	28.00	22.82	24.10	20.28	26.53	Do	do	do.
March	22.45	26 87	30.41	24.25	25.83	21.67	28.19	Do	do	do.
April	31.90	36.30	43.46	35.86	37.66	30.50	39.23	Do	do	do.
May	43.67	50.22	59.00	46.32	51.32	40.22	49.22	Do	do	do.
June	50.76	56.76	62.37	53.53	56.56	48.46	54 40	Observations by Assistant Surgeon C. C. Keeney.		
July	58.00	64.87	71 00	61.32	64 48	55.90	60.80	Do	do	do.
August	68.48	62.85	67.41	57.48	65.33	54 93	58.70	Do	do	do.
September	51.72	56.23	62 46	52.50	57.16	50.80	60.73	Do	do	do.
October	41 25	44.41	48.67	42.38	45.72	40.02	47.06	Do	do	do.
November	29.33	31.13	33.46	29.33	31.40	28.66	32.13	Do	do	do.
December	16.38	19.06	20.12	18.16	18.27	16.06	19.41	Do	do	do.
1846.										
January	23.29	25.03	28.74	24.54	25.38	22.70	27.61	Do	do	do.

Meteorological register—Continued.

Year and month.	Thermometer detached.					Wet bulb.		Remarks.		
	Sunrise.	9 a. m.	3 p. m.	9 p. m.	Daily mean.	Sunrise.	3 p. m.			
1846.	°	°	°	°	°	°	°			
February.....	16.35	18.53	23.32	18.17	19.83	16.28	22.67	Observations by Assistant Surgeon C. C. Keeny.		
March.....	27.64	32.34	36.38	30.29	32.04	27.22	34.54	Do	do	do.
April.....	34.26	40.06	45.96	36.76	40 04	33.80	44.70	Do	do	do.
May.....	45.87	53.29	60.19	48.77	53.35	45.32	58.83	Do	do	do.

The above are the *means* of the monthly thermometrical observations taken at Fort Wilkins while occupied by troops. They are taken from the monthly meteorological registers received at this office.

SURGEON GENERAL'S OFFICE, *December* 1, 1848.

ALEX. S. WOTHERSPOON, *Assistant Surgeon U. S. A.*

alalogue of specimens forwarded to Dr. Jackson by John Locke, December, 1847.

Those specimens marked "Locke" are retained by him. In general, ose from one locality have been numbered together consecutively; but they were not all unpacked at the time, there is more or less of a sprinkıg of scattered specimens through the whole series, especially of the spemens from Presq'isle.

I.—*Presq'isle.*

Number.

1. Not magnetic.
2. Do.
3. Do.
4. See 54.
5. Do.
6. See 35.
7. Scarcely magnetic.
8. See 38.
9. See 54.
10. See 35.
11. See 54.
12. Do.
13. See 35.
14. Do.
15. Do.
16. See 54.
17. Do.
18. Do.
19. See 35.
20. See 54.
21. See 35.
22. See 54.
23. Not magnetic.
24. See 54, fine specimen.
25. See 54.
26. Do.
27. See 35.
28. Do.
29. See 54.
30. See 35.
31. See 54.
32. See 35.
33. See 54.
34. A pebble, veined in the Presq'isle manner.
35. Magnetic—feebler than 54.
36. Lead not magnetic.
37. See 54.
38. See 35.
39. Do.
40. See 54.

Number.

41. See 26.
42. Ferruginous, but not mag'tic.
43. See 76.
44. See 35.
45. See 7.
46. See 54—feebler, however.
47. See 54.
48. See 38.
49. Do.
50. See 54, but feebler.
51. See 35.
52. Pyrites, lead, and part magnetic, (Locke.)
53. Do. (Locke.)
54. Strong polarity.
55. Do.
56. Pyrites, magnetism feeble.
57. See 35.
58. Do.
59. See 54.
60. Do.
61.
62. See 54.
63. Do.
64. Do.
65. Do.
66. Feeble.
67. Has polarity.
68. Do.
69. See 52.
70. Lead and spar, magnetic.
71. Not magnetic, (Locke.)
72. Do.
73. See 76.
74. Polarity.
75. 12-hedral, cryst. lead.
76. Pyrites and lead, not magnetic.
77. See 82.
78. Lead, not magnetic.
79. Veined trap, not magnetic.

Number.

80. See 82.
81. Calc. pyrit. galena, magnetic.
82. Galena, not magnetic.
83. See 35.
84. 8-hed. cryst. galena, not magnetic.
85. Cryst. of galena.
86. See 101.
87. See 54.
88. See 35, (Locke.)
89. See 54.
90. See 101.
91. See 54.
92. Do.
93. Do.
94. See 35.
95. Do.
96. See 54.
97. Not magnetic.
98. See 84.
99. Nodule, in midst of veined trap, not magnetic.
100. See 162.
101. Small, but with decided polarity.
102. See 123.
103.
104. Not magnetic.
105. See 36.
106. Do.
107. Iron ore, magnetic.
108. Do. not magnetic.
109. See 123.
110. See 112.
111. See 123.
112. See 108.
113. See 123.
114. Pyrites, not magnetic.
115. 12 hed. cryst. galena, not magnetic.
116. 8-hed. cryst., not magnetic.
117. Not magnetic.
118. Do.
119. See 108.
120. Glossy iron ore, feebly magnetic.
121. See 108.
122. Jusper, not magnetic.
123. Ferruginous, not magnetic.

Number.

124. See 112.
125. Veined trap, not magn
126. Do.
127. Black augitic trap, ma
128. Do. do.
129. Not magnetic.
130. Do.
131. See 129.
132. Do.
133. Do.
134. Do.
135. Do.
136. Do.
137. Do.
138. Do.
139. Do.
140. Do.
141.
142. See 127.
143. See 129.
144.
145. See 129.
146.
147.
148. See 129.
149. (Locke) trap.
150. Sandstone, (Locke.)
151. Trap, (Locke.)
152. Do. do.
153. Do. do.
154. Veined trap, (Locke.)
155. } Duplicates of above
156.
157.
158.
159.
160.
161. Sandstone, includin chalk.
162. Iron ore.
163. Do.
164. Do.
165. North side Presq'isl cop.
166. Very heavy ox. iron.
167. Ferruginous cellular
168. Carb. lime and iron, (island.)
169. Black magnetic trap.

II.—*Anse.*

Number.
170. Lustrous slate.
171. Sandstone, resembling ortite.
172 Ferruginous quartz, cryst.
173. Slate.
174. Do.
175. Do.

III.—*Iron mountain—range* 27, *township* 47, *section* 2.

176. Riband iron ore.
177. Presq'isle iron ore.
178. Gray oxide iron.
179. Do. do.
180. Iron, gray and red oxide.
181. Metallic slate.
182. Magnetic riband iron ore.
183. Magnetic riband iron ore.
184. Laminæ curved.
185. Slate from Cross island.
186. Slate containing pyrites.
187. See 183.
188. Riband iron ore, inclining to jasper.

Range 25, *township* 48, *section* 11—*Dead River falls.*

189. Metamorphic slate with white veins.
190. Do.
191. Do.
192. Do.
193. Do.
194. Do.
195. Imperfect quartz.
196. Porphyritic sienite, Dead river.
197. Porphyry, Middle island. Owl island a wrong name—should be "*Middle island.*"
198.
199.
200.
201. See labels.
202. Heavy and black. Look for tin.
203, 204, 205. See labels.
206. A vein through it.

The Anse again.

207. Slate.
208, 209, 210. Slate from Anse.

Granite point—range 25, *township* 49, *section* 34.

These specimens are labelled erroneously from Middle island.
211. Carb. lime and iron.
212. Augite or hornblende, a boulder.
213. A vein in sienite (Middle island.)
214 and 215; a boulder, at Granite point.
216. Sienite, (Cross island.)
217. Sienite, Savine island, range 29, township 49, section 32.

No. 218. Sienite, range 25, township 49, section 29.
219. Granite point again.
220. Granite point, near the trap.
221. A boulder, Savine island.
222. Presq'isle, trap.
223. Carp River P. O.
224. Quartz, Carp River P. O.
225. Range 25, township 48, section 2.
226. Cross island.
227. See label.
228. Altered sandstone, Nebish rapids.
229. Do.
230. Cross island quartz.
231. Metamorphic slate with pyrites.
232. Boulder, range 25, township 49, section 29.
234. In place, range 25, township 49, section 29.
235. Metallic slate, range 25, township 48, section 24.
236. " " 25, " 49, " 29.
237. " " 25, " 48, " 11.
238. " " 25, " 49, " 29.
239. " " 25, " 48, " 11.
240. " " 25, " 41, " 14.
241. " " 25, " 49, " 29.
242. Granite point sandstone.
243 and 244. See labels.
245. Sienite and epidote near Mount Burt, range 25, townsl section 29.
246. See 241.
247. Mount Burt.
248. Mount Burt.
249. Granite point.
250, 251, 252, 253. Presq'isle.
254. Middle island.
255. Cross island.
256. Middle island.
257. Granite point.
258. Reddle, Granite point.
259. Boulder, Granite point.
260. Do.
261. Middle island.
262. Falls of Dead river.
263. Granite point, carb. lime and iron.
(Does it contain carb. copper?)
264. Epidote, shore near Mount Burt.
265. Falls of Dead river.
266. Iron mountain.
267 and 268. Cleveland location.
(These two last, although fine grained, have a less s gravity than the gray ore of the Jackson compan
269. Carp River P. O.
270. From slate quarry near Teel lake.
271. As above, (Locke.)

No. 272. See 270.
273. See 270.
274. Metallic sandstone, Nebish rapids.
275 As above.
276. As above, beautifully ripple marked.
277. Nebish.
278. Nebish, ripple marked.
279. See 274.
280. Boulder near Mount Burt. (Locke.)
281. Trap dike. See label.
282. As above.
283. Pebble, mouth of Dead river.
284. Nebish.
285. Nebish, (Locke)
286. Nebish, rippled.

Rapids of the Sault.

287 to 299. Sandstone near the head of the rapids.
300 to 310. Echo lake copper; Echo lake limestone.
311.
312. With tooth-like projections.
313.
314. Slate with conglomerate pebbles, or crystals of porphyritic sienite.
315 and 316. Locke.
317 to 320. Limestone.
321. Trap?
322.
324. See 314.
325 to 327. See 312.
328, 329. Metallic slate in the limestone, with diluvial scratches, found close to the lake shore.
330. As above.
331.
332. Showing seams of altered and contorted slate in the limestone, the vestiges of original stratification.

Camp, August.

333 and 334. Depletes of sandstone from a boulder.
335. Probably from Pictured rocks.

Bruce mine.

[A, B, and C, indicate different portions of the mine, A being the lowermost or southwardly.]

No. 335—B.
336—B.
337—B. Gangue.
338. (Locke.)
339—B.
340—C.
341—B.
No. 342—C.
343—C.
344—B.
345—C.
246—A.
347—A.
348.

No. 349—A.
350—B.
351—C.
352—C.
353—C.
354—A.
355.
356—B.
357. Locke.
358—A.
359. Carb. copper. This was the first discovery of the mine.
360—B.
361.
362—A.
363—B.
364—A.
365—A.
366—B.
367—C.
368—B.
369—A.
370.
371—A.
372—C.
373—C.
374.—A.
375—C.
376—A.
377—C.
378—B.
379—C.
380.
381—C.
382—B.
383.
384—C.
385—C.
386—B.
387—B.

No. 388—A.
389—B.
390—C.
391—B.
392—B.
393—C.
394—A.
395.
396.
397—A.
398—C. Carb. cop
399. Echo lake.
400. Echo lake.
401—B.
402.
403—B.
404—C.
405—A.
406—B.
407—B.
408—A.
409—C.
410—A.
411.
412—C.
413—C.
414.
415—C. Trap ro mine.
416 to 420. See 41
421. Trap; augitic er basaltic; rods from strongly m
422 and 423. See a
424—Trap.—C.
425. Next to the v wall."
426—C. Wall and
427—C.

Two miles west of Bruce mine.

428. Jasper; conglomerate.
429, 430, 431. See above.
432. (Locke.)
433. Jasper, in place.
434. See 428.
435. Bruce mine. See 421.
436. Like specimen 314.
437. Associated with limestone.

No. 438. Trap.
439. Limestone similar to that at Echo lake.
440. Metallic slate?
441 and 442. Metallic limestone.

Pictured rocks.

443 to 448, Grand island.
449 to 452. Grand Portal.
453. Grand island.
454. Portal rock.
455. Sparsy from Portal cave.

Fucoids from Grand Portal cave

456 to 471.
Retained to make drawings from, 472 to 476.

Probably from Presq'isle.

477.
478.
479.
480.

The Anse again.

481 to 491. No. 489 very heavy.

Presq'isle again.

492 to 509.
497. Magnetic.
499. Heavy, but scarcely magnetic.
507, 508, 509. Magnetic.

Carp river and vicinity.

510. Cleveland location iron.
511 to 515. Jackson Company iron.
516. Not soapstone, but a soft trap.
517.
518. Contains pyrites.
519. Dead river porphyritic sienite.
520 to 522. Copper ore.
523 and 524. See labels.
525. Pyrites.
526. Prismatic slate. The structure resembles that of the hone slate below.
527 and 528. Hone slate or novaculite, range 26, township 48, section 30.
529. See 515.

No. 530. Near Tobacco river.
531. Near do
532. Near Tobacco river (Locke.)
533. See 511.
534. Presq'isle.
535. Loadstone, range 26, township 48, one-eighth mile north section 18.
536 to 538. See 535. (535 Locke.)
540. Augitic trap?
541. See label.
542. Sienite (porphyry) of Esconawby.
543.
544. See 542.
545. Beautiful sienite (porphyry) of Esconawby Falls.

Sandstones, not of "Train Point," but of a point west of it.

546 to 552.
549 to 551. Sulphate of baryta.

Miscellaneous.

553. Carp river.
554. Anse, ferruginous.
555. "Slickensides" slate, Anse.
556. As above.

Nodules from Grand Portal.

557 to 582.

"Supposed fossils" of Grand Portal—more probably crystals of spar iron, or iron and carbonate of lime.

583 to 592.

Miscellaneous.

593. Copper vein. See label.
594. Bruce mine.
595. Iron Jackson mine.
596 to 604. Parcel from Presq'isle mine.
605. Locality unknown.
606. See label.
607 and 608. Carp river.
609. Metallic sandstone, Carp River P. O.
610. Metallic sandstone, Carp River P. O.
611. Gros cape, vesicular trap.
612. South end Middle island.
613. Spathic iron, Granite point, (Locke.)
614 to 617. Presq'isle.

No. 618. Carp river.
619. Pictured rocks, (Locke.)
620. Portal rock, showing white stains.
621. Pictured rocks, (Locke.)
622. Near Miner's river.
623. "Hair salt" efflorescence.
624. Do
625. Do (Locke.)
626. See 622.
627 to 630. Sulph. baryta, Grand Portal, (630 Locke.
631 to 633. Presq'isle.
634 to 636. Gros cape.
636 and 637. (Locke.)
638. Trace green carb. cop., Gros cape.
639. Epidote, Gros cape.
640. Amygdaloid, Gros cape.
641. Laumonite, Gros cape.
642 to 645. Gros cape.
646. Sandstone, with green stain, (Pictured rocks.)
647. Presq'isle, sulphate of iron.
648. Do do

Fossiliferous.

649. Great orthocera from St. Joseph's island; 5 feet long, 8 inches in diameter; joints about 3 to the inch, and making in all about 180 chambers; sephuncle large, well marked, and filled with crystals. (See drawing.) Posterior end contracts abruptly within 2 or 3 inches of the termination.
650. A piece (A) which fits 649, at the point A.
651. A piece (B) which also fits 649, at the point B. These two pieces should be glued on to their places.

Pentamerus oblongus.—"Range 4 east, township 42, section 17; G."—Collected by Dr. Channing, "promontory S. 8° E. from the old fort on St. Joseph's."

No. 652 to 841.
842. Orthocera, fragment, St. Joseph's.
843. Pentamerus oblongus, var. foliatus, retained.
844. Calamipora and cyathophyllum.
445. Do.
846. Pentamerus and cyathophyllum.
847. Calamipora.
848. Chert and calamipora.
849. Is it cyathophyllum?
850. Calamipora.
851. Do.
852. Cyathophyllum, calamipora, and univalor.
853. Calamipora.
854. Univalor.
855. Calamipora.

No. 856. Calamipora and pentamerus.
857. Calamipora.
858. Pentamerus and cyathophyllum.
859. Calamipora.
860. Do.
861. Pentamerus oblongus.
862. Calamipora.

Cross island and *Savine island* are small rocks within hail of Middle island. They are not well put down on the maps. One has a cross of trap dikes; and the other, the more remote one, produces the true jamiperus sabina.

Several specimens have been labelled "Middle island" which should have been *Granite point*. The brown spar, consisting of carbonate of lime and iron, was from Granite point.

CINCINNATI, *January* 23, 1848.

DEAR SIR: I enclose to you a catalogue of the specimens which I have forwarded, which professes to be little more than a kind of duplicate record of locality. In several cases I have made notes on the magnetism of the specimens. Those from Presqu'isle are remarkable in that particular, especially such as contain carbonate of lime, sulphuret of lead, sulphuret of iron, and sulphuret of copper. I presume their magnetism is due to protosulphuret of iron. I should think it would be interesting to analyze some that are most highly magnetic—as No. 54, for example, which is not only magnetic, but possesses decided polarity. I am now engaged in the actual labor of the report, and shall be happy to receive any suggestions from you. How soon will it be wanted? I ask this question because of some of the maps and illustrations which I am procuring, and which will require a little time.

Yours,

J. LOCKE.

DR. JACKSON.

United States geological survey of public lands in Michigan.—Field-notes.

July 8, 1847.—Camping ground near Horseshoe Harbor. Rocks conglomerate—mixed with sandstone, which occurs in thin slaty strata, the surfaces of the strata being gray, and having a shaly appearance. The pebbles of the conglomerate are, among others, compact and vesicular trap, chlorite, porphyry, and carbonate of lime. Color of the sandstone red, grains coarse. Isolated rock on the beach in place. Course, W. 5° S., E. 5° N.; dip, 40° N.

July 9.—Barometer at the house taken as the lower station, and at the summit of the mountain above Lake la Belle:

At the house, 11h.—B. 29.269; T. 29.6;—B. 29.282; T. 29.3.
At the summit, 4h. 40′—B. 28.644; T. 24.5.
At the house, 5h. 40′—B. 29.216; T. 24.
At the lake, 6h.—B. 29.502; T. 23.
At the house, 6h. 35′—B. 29.212; T. 23.5.

July 10.—Mount Houghton. Barometer broken. The summit of the mountain and irregular ridge running E. to Lake Superior 5¼ miles, coming out on the shore just beyond the little Montreal river; consists of a red striated rock; hard like jasper; cleaveable in laminæ. It suggests the idea of a sand rock indurated by heat. It can be separated in very distinct strata bearing W. 5° N., dip 60°.

July 11.—Ascended Mount Houghton again, and attempted to find the junction of the jasper and trap, but it was covered by the soil, and must be examined on the lake shore. The trap at the foot of Mount Houghton on the south shore is black with a fine grain, occasionally amygdaloidal. On approaching the jasper the trap becomes coarser in grain and reddish. The nearest part of the jasper to the trap is amorphous and massive in structure, with a coarse grain. Higher up it becomes stratified or laminated, so as to cleave into even and thin plates. The jasper scratches steel, and strikes fire freely. Specimens of the various rocks taken.

July 12.—At the north point of Keweenaw the trap is amygdaloidal, with nodules of chlorite, and what proved to be mesole and henlaudite; also, abundant nodules of agate and masses of laumonite. Specimens taken for Dr. Jackson.

July 17.—Point half a mile north of Tobacco river, palisades of horizontal sandstone 20 feet high. The red and white sandstone alternate as usual in this formation; but the red sandstone is slaty in structure, almost approaching shale. The most remarkable circumstance is the occurrence, at intervals of about 8 feet, of strata of a very coarse, almost gravelly sandstone, cemented partially by a white pulverulent substance, probably carbonate of lime, to be examined in the specimens. These strata are about two feet thick, and look like decayed limestone at a little distance.

July 20.—L'Anse, eastern side, south of Methodist mission half a mile. Sandstone in thick strata, alternating with strata of slaty structure. Apparent course, E. and W.; dip, 30° N. For the slaty strata, a false cleavage of 13° inclination to the NNW. Pebbles occur occasionally in the sandstone, showing a tendency to conglomerate. Color of the thick strata lighter than the slaty, which are red.

One-half mile further south the strata are much contorted, and the shaly structure increases; slate then occurs, sometimes striated and nearly approaching hornstone. In the midst of this occurs a compact white slate, used for whetstones, of fine grain, and separating into suitable slabs. Specimens taken. Several arches occur in the stratification of the slate, where the strata have been pushed up from below, and masses of a trappean rock at length appears under the slate. North of these the dip is generally north; south of them the dip is generally south. The trappean rock contains fragments of slate distributed through it, and converted into hornstone when in small pieces, like the erupted granite of Pigwacket mountain, New Hampshire. Large veins of quartz occur in the slate, ferruginous and containing cavities with crystals. A black mineral, of which specimens were taken for examination, occurs in small quantities with the quartz, and also a white pulverulent substance, probably kaolin. With the slate occurs talc and asbestos. The whole region above described is very interesting, and will reward more minute observation.

July 21.—Presqu'isle, New York, and Lake Superior Mining Company. The vein is in a light green trap, reticulated with white veins near the junction of the sandstone with which the trap is apparently interfused. The vein crosses a large gulley on the shore, appearing on both sides. Course, W. 40° N.; dip, 2° (N. 40° E.) The walls of the vein are lined with fibrous asbestos, galena, and sulphuret of iron; also, arsenical sulphuret of iron observed in the vein. Thread veins occur in the neighborhood. Width of the principal vein on the face of the rock, from a mere thread to 6 inches, distributed much in pockets. A shaft sunk and drifts carried in NW. and SE.; these are now full of water. Another vein on the point further to the east has also been opened. Carbonate of lime occurs crystallized in several forms. Oclohedral galena also occurs in fine specimens. Specimens of the ore containing copper pyrites raised from the shaft, and other minerals taken.

The junction of the trap and sandstone on the east of the point is very interesting. The trap is veined, sometimes with carbonate of lime, and sometimes apparently with silicate of lime, and also with quartz. It presents a rich marbled appearance. The sandstone also seems to have been fused or mingled with the trap. On the east side the trap frequently presents caverns at the water's edge, from the decay of the rock. There is one deep cavern, probably over 100 feet high and deep, varying from three to eight feet in width, formed by the decay of a more recent dike of black trap, seen above. A recent dike of very hard and black trap occurs on the face of the rock on the east side.

July 24.—From the warehouse near the mouth of Carp river, nine miles to the dam building on the river, range 26 west, township 48, section 28, southeast quarter section, vein of quartz containing copper pyrites, course west-northwest, in metamorphic state. Quartz-vein varying in width, containing from mere threads to one or two feet. The ore is in threads and bunches in the quartz. Specimens taken. The slate deeply furrowed with "drift scratches" on the surface. Course east and west. A permit located on this vein. Traces of green carbonate of copper are also found in the quartz. Cubical pyrites, apparently "brown pyrites," occurs in the slate adjoining the vein.

In range 26, township 48, section 26, occurs a vein of quartz, containing threads and small bunches of copper pyrites, and traces of green carbonate. Course of vein about east and west. The rock in place at the vein is metamorphic slate.

Mr. McNair informs us that in the adjoining hills in township 48, range 26, there are several veins of quartz containing traces of copper of a similar character.

The route from the warehouse near the mouth of Carp river, in township 48, range 25, and township 48, range 26, is through metamorphic slate. This almost passes into trap near the lake, but becomes distinctly stratified and passes into clay and talcose slate higher up.

The metamorphic slates already spoken of contain frequent thread veins of carbonate of lime, and also quartz. Occasionally, where the rock appears most changed, it contains quartz, and apparently felspar, in separate particles, diffused through the mass.

July 26.—Opposite the house of Mr. McNair on section 33, township 48, occurs a ridge of talcose slate, on the top of which are "drift" scratches. Course west 16° north, sharp and accurately measured. Above and be-

ind this occurs a perpendicular barrier of quartz, whose course is east nd west—width not determined, but estimated at forty rods. It extends vest from Carp river to the whetstone quarry in section 30, and beyond. This quartz is ferruginous, and contains micaceous iron ore, as it appears o be, so as to resemble in some specimens mica slate. Specimens from this locality are marked "Carp River P. O." (post office.)

The whetstone quarry occurs in section 30, township 48, range 26, adjoining the quartz. The course of the rock is generally north of east, and south of west. Specimens of this taken. It is of excellent quality, and preferred by mechanics who have used it, to any other. It has a cross fracture and a tendency to break in a third direction, if not more, so that whetstones cannot well be broken out, but must be sawed. This will be a valuable quarry. It is on the northeast quarter-section.

The Jackson iron mine, range 27, township 47. It will be in section 1, when surveyed. The direction of the range and of the ridges in the iron rock, about east and west. Length of workable ore less than one-fourth mile. The breadth has been estimated at 1,000 feet, but without precision. Height, by the barometer, taken by Dr. Locke. It extends to the ravine at the foot of the hill, improving in quality as it descends, and reaches nearly to the summit. The surface presents an immense quantity of loose masses, which are supposed to be sufficient for a furnace for many years without mining. The best ore is of a loose crystalline structure, easily broken by the sledge. The faces of some of the crystals are observable by the microscope, but not sufficient to determine their form. A part of the ore (about one half on the surface of the ground) consists of "ribbon" ore, striated with red veins, which deserve examination to ascertain their nature and influence on the ore in the furnace. A third variety consists of the slaty ore, a compact, pure ore, equal in quality nearly, if not quite, to the crystalline.

Following the western line, south of range 26, township 47, sections 6 and 7. Iron boulders and angular masses of ribbon ore. Ferruginous quartz on pinnacle of hill, just past the corner of section 6. Slaty iron ust past quarter-section mark of section 7.

6h., metamorphic sandstone. 6h. 10m., iron ore, fine grain. Section 7, just before corner of section 18, talcose metamorphic slate of a bluish color, somewhat crystalline.

July 27.—At camping-ground, iron highly magnetic. Position about one-eighth mile south of the north line of section 18, following, as above, the west line of township 47, range 26, in a south course. One north and one south magnetic pole, round which the needles were reversed within a foot. The compass wild. Distance between the poles, 17 feet 3 inches, in a direction east and west. Soil full of angular fragments of loadstone. Ledge of compact stratified iron ore, whose apparent course is W. 20° S., dip 39° WSW.—highly magnetic, with strong poles. Part compact black ore; part resembling the ribbon ore of Jackson location.

Going south from the above 5′, sienite; 7′, magnetic iron in place; 15′, magnetic iron ore, associated with metamorphic slate; 48′, silicious metamorphic iron rock, on a high cliff. Course of valley and bluff, S. 10° W.

Standard "augitic rock" No. 1, township 47, range 26, section 18, near southwest corner-post.

Corner-post, 12h. 36m., section 19, near northwest corner. Iron ore, slightly magnetic; compact, but not of the highest specific gravity.

2h. 20m., quarter-section post. 2h. 27m., stream running east. 2h. 35m., iron ore, compact, light. 2h. 42m., iron ore, compact, heavy; top of ridge. 2h. 44m., corner-post, section 30. 2h. 50m., ascended pinnacle of an iron mount, 60 rods to the east of the line of section 30. Iron ore, slaty or earthy, impure. Barometer observed by Dr. Locke. Time of starting on trail again, at place near where we left it at 2h. 50m., as above, was 3h. 12m. 4h., left Lilly pond. 4h. 6m., iron ore. 4h. 8m., top of ridge, E. and W. 4h. 10m., sienite, with red felspar. 4h. 19m., ridge, summit; course W. by S.; sienite, obscurely marked with veins of iron. 4h. 28m., rock of quartz and light red felspar. 4h. 32m., "augitic rock" No. 1. 5h. 50m., quartz and felspar rock, in fine grains; also, coarse, with large masses of felspar; also, granite, or gneiss, much interrupted by quartz veins. 6h. 55m., ridge W. 10° S. 7h. 2m., ridge, W. 10° S.; ridge north of the east branch of the Esconawby, on township line, course W. 20° S.; red felspar sienite. The rocks for two miles back, mostly "augitic rock" No. 1 and sienite. The red sienite above, in range 26, township 46, section 6, is taken as standard No. 2. (See page 586.)

July 28.—10h. 34m., section-corner, section 7, township 46, range 26. 11h. 30m., crystallized felspar and quartz. Rocks of late, sienite No. 2. 11h. 45m., swamp, rocks sienite, with white felspar. 12h. 25m., section-corner, section 18. 1h. 20m., sienite, gray and well defined; a rounded ridge of 30 or 40 feet, course SSE. and NNW., just before quarter-section post. 2h. 10m., section-corner, north line of section 19. 2h. 40m., stream, north side; rock of quartz and hornblende, hornblende slate; on south side, red sienite, (No. 2.) 4h. 40m., dark brown sienite. 4h. 58m., section-corner, north line of section 30.

Rapids on the Esconawby, following left or east bank of the river southward, one-fourth mile below its intersection with the township line. Rock highly crystalline red sienite.

Rapids of the Esconawby, in the bend of the river, and in township 46, range 27, section 25, one-eighth mile from the preceding. On the left side, gray sienite, crystalline and exceedingly hard, with surface polished. On the right bank, the same sienite occurs, but the felspar Indian-red, and highly crystalline.

Little Falls, one-third mile below, in township 46, range 26, section 30, gray sienite.

Rapids, 9h., porphyritic sienite, gray. 9h. 15m., porphyritic sienite, gray. 9h. 45m., Great Falls, sienite, with red felspar, in large crystalline masses, color very deep; just below, "augitic rock" No. 1; and about 20 rods southeast, on the hill-side, range or bluff of sienite, course N. and S. 11h. 10m, "augitic rock" No. 1. 11h. 23m., sienite, gray and porphyritic.

12h. 30m., south line of township 46, range 26, where it touches the river. 1h. 20m., white sienite, with hardly any hornblende. 1h. 25m., falls, red sienite, containing mica.

3h. 20m., Indian trail, N. 20° E. 3h. 30m., course N. 3h. 35m., crossed stream and prairie, stream running S. E. 3h. 56m., coarse light-red sienite; trail N. 55° E. 4h. 30m., crossed E. and W. surveyors' line, close to a large stream; course of trail N. 5h. 35m., arrived at camp on stream running NW.; trail also NW.

July 30.—Started at 8h. 45m. 9h., light reddish sienite on summit;

trail-course NE. 9h. 2m., N. and S. surveyors' line. 9h. 10m., ridge NW. and SE. 9h. 14m., stream running SW. 9h. 45m., light-colored sienite. 9h. 50m., red sienite, with fine grains, on a ridge; the ridge to the south, as well as the present one, runs NW. and SE.; course of trail NE. 9h. 56m., gray granite, probably in place. 9h. 58m., before crossing east branch of Esconawby, red sienite. 10h. 2m., east branch, running ESE. 10h. 20m., hornblende slate, dip NE. 10h. 25m., small branch of river, course SE.; trail-course N. E.; north side of stream, red sienite, intermingled with gray gneiss. 10h. 35m., hornblende slate. 10h. 40m., red sienite. 11h., red sienite. 11h. 5m., ridge E. and W.; trail N. by E. 11h. 15m., coarse and fine red sienite, with veins of quartz several inches broad, well defined. An E. and W. surveyors' line comes in here, and pine plains commence immediately after. 11h. 40m., ridge-course E. 1° N. 11h. 48m., fine sienite. 11h. 55m., N. and S. surveyors' line; trail N. 30° E. The general course of the trail has been for two or three miles N. 20° E.

12h. 10m., valley on the right, N. and S.

1h. 20m., lake; 3h. 45m., stream running E. by S.; 4h. 25m., abrupt ledge of quartz; course NE.; opposite to it on the trail, clay, slate somewhat changed; quartz continues for one-quarter mile. Section corner on township line at about 5h. 30m.; Lake Superior at about 6h.

July 31.—About 1 mile north of Carp river along the coast, clay slate occurs, dip nearly vertical; course nearly E. and W. A little distance beyond to the north the slate is found highly metamorphic, and a trappean rock occurs, apparently blending with the slate; a specimen of this taken. The trap rocks seem thus to be frequently interfused with the metamorphic rocks in this region, and sometimes to receive even a stratified structure, when slightly changed from their original type.

Specimens of iron ore from the Cleveland location, kindly furnished by Mr. McNair. They consist of a very compact ore, with fine grain—a variety occurring in small veins, and probably not existing in large quantity. The Cleveland location is in the southern part of T. 47, R. 27.

With regard to the metalliferous character of the region to which these notes, from July 24 to July 31 inclusive, refer, there can be no doubt in placing the coarsely crystalline sienite of the Esconawby and southern part of the primitive district apart from the trap and copper-bearing rocks of Lake Superior. The fine-grained sienite near the junction with the metamorphic rocks may be nearer to the copper-bearing rocks; but a search for copper in them would probably be unprofitable, and a liberal policy would separate them from the mineral district. With regard to the metamorphic rocks there is more doubt, and a general opinion cannot perhaps be properly given. The veins of quartz-bearing copper in R. 26, T. 48, and those at the Anse, deserve close examination for gold, silver, and other rare metals. Veins of this description, if they prove important, can undoubtedly be found in the metamorphic rocks.

August 2.—Rock at the mouth of Dead river, resembling sienite, but apparently consisting of quartz, white and black, felspar, and epidote, with occasional cubes of iron pyrites. It is intersected with veins of epidote and quartz; specimens taken. Some of the seams of the rock, when broken open, are found lined with chlorite.

Dead River falls, one mile above mouth; bed, between ridges of quartz and felspar, rock, consisting of altered talcose slate; course W. 10° S.

Quartz and felspar are seen in particles in the slate, and seams of chlorite in the quartz and felspar rock. A light pink-colored mineral found in the bed of the stream, interstratified with the talcose slate. This examined for lithia by blowpipe, but considered a silicate of lime, though requiring further examination.

August 3.—Owl island, bearing due west from the west point of Presq'isle. Fine red sienite, containing seams of changed chlorite slate, which contain particles of quartz in some places, where in contact with the granite. Course of veins of slate generally SE. and NW. Surface of rocks near the shore smooth, and marked with "drift scratches" SSE., following the course of the lake shore. Estimated height of the island 120 feet. Deep fissures occur where the slate has decayed out. On the side E. by S., a trap dike occurs 3½ feet wide, course WSW. It is of the hornblendic variety. Near the dike the sienite is redder than elsewhere. Further to the south is a vein of changed chlorite slate, having the same course, and appearing to pass into trap. The pink-colored mineral found at Dead River falls also occurs here. On the west side a trap dike occurs, probably the same noticed on the east, and to the SW. a dike of gray compact trap, containing apparently arsenical pyrites, but deserving further examination. Near this dike occurs an intervenation of sienite and trap, which are also evidently interfused with each other for an area of several yards. Hornblende slate and chlorite slate also occur, mingled with the others; a narrow vein of carbonate of lime also occurs.

Large island, off the first point west of Presq'isle. On the east side a junction of trap and sandstone occurs; a narrow vein of conglomerate is found between the two, as on Presq'isle. Further south, going towards the beach, true conglomerate comes in, and large and numerous boulders and fragments of hornblende rock cover a portion of it. The conglomerate extends perhaps one-eighth mile. A vein of sienite appears at one place on the shore, passing under the sandstone, which seems to have been upheaved by it. The end of the point appears at a little distance to be sienite traversed by dikes of trap. The south side of the island rock, consisting of quartz, epidote, hornblende, and garnet. Foot of Mount Burt, on the lake shore, a trap dike 20 feet wide. The edges of this dike are compact greenstone; the interior, after two or three feet, hornblendic trap, showing a different character, resulting simply from crystallization and the process of cooling rocks in place; red sienite, with frequent veins of epidote. The sienite is much cut up, and veined by offsets from the trap dike. The sienite must have been colder than the trap, to chill it at the sides; yet in a soft condition, to allow the veining of the trap. Some of the offsets of the trap resemble what I have called, in speaking of Owl island, changed chlorite slate. This is the best description of its appearance, but its position would make it seem to belong to the trap.

A trap dike occurs about 150 yards west from the above, 27 feet wide, and showing the same difference of structure within and at the sides. It is marked also by "drift" scratches NW. by N.

Mount Burt.—Red and gray sienite, traversed by trap. Ascent easy, though rapid, three-eighths of a mile, at an angle of 18° to the summit; the cliff bald towards the lake, giving a magnificent prospect.

Point No. 2, west of Presq'isle. A junction of red sandstone, with sienite, occurs near the point. A mass of sienite makes its appearance

junction, under the sandstone, which seems to be but slightly in-
ed by it. The sienite consists of quartz, hornblende, and epidote
ally. The point, seen at a little distance, seems to consist of
, intersected with dikes of trap.
bluff of sandstone has, at intervals, narow strata of conglomerate,
ing all the sandstone bluffs we have visited. In some of the
however, of this locality, the pebbles are cemented with carbonate
, which has not been observed before.
t No. 1, west of Presq'isle. As seen at a little distance, red sienite.
ie beach, upon the ridge, a ledge of white quartz occurs.
q'isle, August 3.—I obtained more specimens of galena, crystallized
ral forms. I noticed the octahedron, the octahedron compressed
spar (the terminated six-sided prism,) and dodecahedron. These
s occur either in calc spar, or an earthy mineral, which decays and
them to be detached. They thus present a perfect crystalline
on all the faces, the prisms being terminated at both extremities.
prisms deserve further examination by Dr. Locke, before a report,
rtain that they are distinct from elongated rhombic dodecahedra.)
ust 6.—Train point, west end, a flat table of sandstone 1 to 2 feet
he water; stratification horizontal; also, a remarkable slaty cleavage
stratification, dip 26° N. by E. This cleavage is so regular as to
momentary doubt upon the true stratification, which is massive;
avage being in their strata of an inch or an inch and a half. The
ne coarse, and at the bottom of the lake horizontal and tabular in
ation.
point of Train point, one mile from the preceding, cliff of sand-
35 feet, with alternate red and white strata; grain fine. Sandstone
his point, and to the south of it, occasionally excavated into arches
feet high from the water. The partitions between two of these
are often perforated, so as to leave a pillar supporting two arches.
fect of this is very picturesque. The arches in the Pictured rocks
well known example on a large scale. Specimens of the white
k taken.
markable isolated arched rock occurs at the extremity of Echo
height 9 feet. The sandstone here is stratified horizontally, but
d with a fissile structure, dipping N. by E. 15° to 20°. This
e considered a stratification, and the horizontal cleavage a tabula-
ut the other is undoubtedly the correct view. The rock coarse,
sandstone, gray at this point, but alternating with red farther to
t. Rocks frequently arched. These arches and colonnades are
ly produced by the abrasion of the rock by the water at the lake
, and the subsequent crumbling in of the rock from above. The
direction of natural fracture in cleavage and stratification must aid

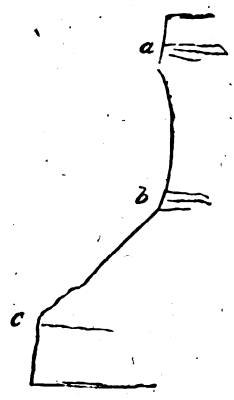
cho point a thin vein of sulphate baryta found in the sandstone,
ompact, partly crystalline; color light pink.
d island, west side. High bluffs of sandrock observed two miles
, about 200 feet from the water to the highest exposed surface.
ce of the cliff divided occasionally by trees coming down to the
edge. Stratification horizontal, and marked by gradations of

ust 8.—Grand island, southwest side. An arched excavation in the

cliff, 80 feet high, the roof projecting 25 or 30 feet over the water. Sandstone red and white, coarse, variegated, the lines of cleavage being shown by the colors, and much contorted. Stratification nearly horizontal, dip 4°, (north 40° east.) Pebbles in the little cove, clear quartz, approaching agate. These undoubtedly come from the sandstone, in which they are also found imbedded. A succession of cliffs of red and white sandstones, interstratified and variegated. The highest point of these about 200 feet high. Jutting perpendicular promontories frequently make out into the lake. Elsewhere the cliffs incline to the water, at an angle from 45° to 70°. Bushes and trees occasionally find root-hold upon the side or in ravines. The surface is marked by the different colors of the rock, by vertical weather or water stains of black and white, and also by lichens and vegetation and by the lines of fissure. At one point, on the west-southwest side, several arches occur, observed by Dr. Locke, whose bases are about 12 feet above the present level, indicating a higher level at a former period.

The sandstone of Grand island, under the microscope, appears to have a white cement; which, however, does not effervesce with acids. It is probably silicate of lime.

August 9.—Left Grand island at 6h. 35m. Cliffs in the Grand Island channel, on the east side, frequently eaten away at the water's edge into arches and honey-comb. At 8h. 30m. passed a colonnade at a small point, consisting of six or eight pillars at the entrance, and extending the depth of two or three arches under the rock. Height about six feet. Effect a good deal like the Gothic-groined arches of Fontane Abbey. Near this a tower of rock standing alone a short distance from the water, and 40 or 50 feet high. 8h. 50m.—The rocks generally here rise at an angle of 45° to 70°, with occasional perpendicular cliffs. From a level of about 12 feet and downwards, rocks discolored, apparently from the difference of the former level of the water. A depression in the surface of the rocks at about 40 feet height; possibly also from a former level of the lake at that height. Surface of the rocks always moist; occasional small streams trickling and falling over them. Discolored under some strata by oxide of iron, and also by a white slimy substance running down from the crevices.



Profile of cliff at 9h. 20m:—*a*, strata of compact rock, decayed in cavities, and resembling limestone. (This found in fragments on the shore at 8h. 50m.; rough and abounding in concretions hard and fine-grained, with the appearance of limestone, but not effervescing with acids. Specimens taken.) At *b*, former supposed water level of 40 feet. At *c*, ferruginous strata 12 feet above the water. Discoloration of rocks below, either from the iron or former submergence in water.

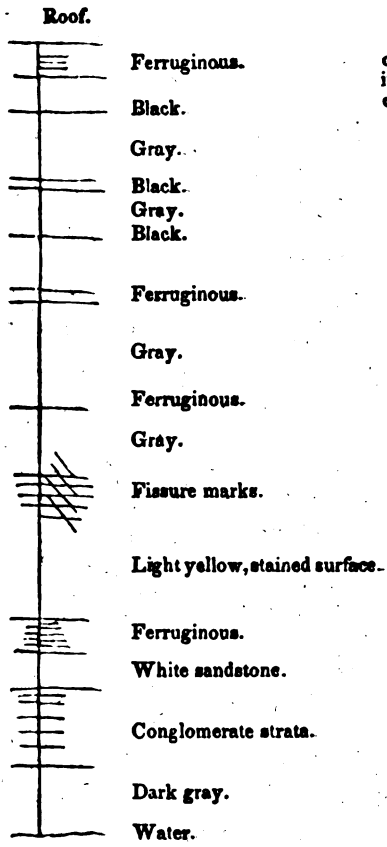
9h., east point of Grand Island channel, consisting of a colonnade of large arches and halls at the level of the water—9h. 30m. to 10h., Miner's river; Pictured rocks—10h. 20m., undulating coast. Rounded battlements projecting, with curved indentations between.

10h. 35m., profile of point:—*a*, trees; *b*, gray earthy stratum; *c*, greenish strata; *d*, striated strata; *e*, pictured with streaks of black, white, yellow, brown, bluish-green, and all intermediate shades. Height of cliff about 150 feet. At the water-line a stratum of conglomerate (*f*) 1 foot thick; pebbles very abundant. At the foot of the cliff, large sail like masses of rock.

West of this point the rock is excavated for its whole height, overhanging the shore 30 or 40 feet. The white substance exuding from the crevices is tinged with light blue, resembling a white precipitated salt, containing copper as an impurity. Specimens of this taken in paper and dried.

11h. 35m., arches occur in the cliff, whose base is 3½ feet above the present level of the water. The precise position of the arches seems to be determined usually by the existence of a fissure, where the rock decays readily. 11h. 40m., overhanging arch 75 feet high, extending to the summit of the cliff. Deep green stains below one of the seams. Rock strongly marked with black, white, and brown, in vertical streaks resembling a painter's board.

11h. 45m., passed the "Sail-rocks" at the foot of the cliff. 12h., passed a prominent point of the rocks 170
. Many small arches and some large excavations occur.
5m., arrived at the "Grand Portal" on the same promontory.
Grand Portal" is a lofty and deep arch in the rock at the ex-
f the promontory; the dimensions taken by Dr. Locke. The
red within, at the rocky beach at the farther end. The strata
finely displayed sandstone—grayish, slightly variegated, and
lines of cleavage in various directions. The stratification is al-
izontal, one of the strata near the top black; some of the strata
us, and long black stains streaming down from them. The
so sometimes consist of the white slime of which specimens
en yesterday. The dip of strata about 3° S.
twelve feet above the water occur several strata of conglomerate,
g mostly of quartz and jasper pebbles, the quartz with a peculiar
crystalline appearance at the surface, and resembling in every
ose found on the beaches of the sandstone. Below this are
ılly narrow vertical veins of conglomerate, consisting, probably,
in the lower strata, filled subsequently with pebbles. The under
f the strata, at about fifty feet high, finely ripple-marked.



[The diagram represents a section of the various strata, taken just within the arch of the "Grand Portal," on its western abutment.]

The rock near the water's edge around the Portal, and in some places within, is worn into arches and colonnades. Specimens of the various sandstones taken. On the face of the promontory, on the eastern abutment of the Portal, is a fine group of arches with low and massive pillars, resembling Egyptian architecture. The interior of the Grand Portal bears a striking resemblance to some of the halls of the Mammoth Cave of Kentucky, particularly to that called "the great city."

Half a mile east of the Grand Portal, at the point of the beach, is another cave, of 40 or 50 feet high, in which the water is deep, over a sandy bottom; gray sandstone, mingled with light red, slaty. Some of the strata finely ripple-marked. The sand on the beach just beyond the above, to the eastward, coarse, consisting of transparent and *rounded* grains of silica, with occasionally a colored particle, (as seen through the microscope.) Specimen taken.

"The Chapel," at the end of the beach. A vaulted room, supported on massive columns; the floor about 25 feet above the water. It stands out from the other rocks and from the woods. Dimensions inside about 25 feet square by 15 feet high. Two or three truncated columns of sandstone

rror arches occur inside. The summit, on which some bushes es are growing, about 60 feet above the lake, commands a very ɔspect. The effect of the Chapel is also highly picturesque from er. Rock coarse, gray sandstone, with rounded particles.

ust 10.—Returned to Grand Portal and got out fossils found by Dr. ɔn masses of rock detached from above, at a height probably between 130 feet above the water. In the ferruginous stratum, about 40 ;h, found some specimens of the same fossil in place in the cliff, rly developed. A vein occurs within the Portal containing a min- h brilliant faces, resembling brown spar. No effervescence with :xcept in the cavities, where a little carbonate of lime is found. A r form of this mineral—a striated, truncated cone, either the form of or of crystallization. Specimens taken to examine for fossils, and gments for chemical examination.

ust 11.—Returned to Grand Portal. Took specimens of the dark tain on the rock for examination. Passed eastward by the Chapel e high bluffs, to their termination, at 10h. 33m. At 10h. 20m. the cascade, falling over a cliff of 100 feet into the water. All of ffs much marked with black stains, sometimes covering most of ırface.

ıe afternoon passed the land cliffs of Grand Sable, and encamped Grand Marais, a protected bay, in which great numbers of shellfish ɔserved.

ust 12, 13, and 14.—The shore sandy. No rocks observable.

ust 15.—Gros Cap, on the Canada shore. Trap rock here appears n heavy dikes, apparently through sienite. The rocks on the ı shore of the St. Mary's continue to be trap, and apparently sie- : two or three miles below Gros Cap.

ust 19.—Descending St. Mary's river 7 miles to Palmer's location, s observed.

ust 20.—North of little Lake George, on the Canada side, high of hills, apparently trap, one to two miles back from the shore. mer states that they contain copper ore. Hills low and wooded ar island. North of Lake George there is another range, exhibit- ɔipitous cliffs towards the lake, with the appearance of trap.

lake, Canada; entrance through a narrow channel or river, four ɔourse NE., from the northern part of Lake George; the lake dis- and named only last year; length two or three miles; surrounded ıntains, mostly of metamorphic and also trappean rocks; on the de, a mountain of limestone, which rock appears also on both ɔf the lake; the limestone blue and much veined, the veins curi- ontorted, and apparently silicious. On the N. by W. shore is the ɔelonging to the northern Echo lake location. To the east of this dike makes its appearance, with a northeasterly course. The ins north and northeast of the lake contain veins of quartz appa- ich in sulphurets of iron and copper, running through metamor- ndstone and slate. Visited the vein opened yesterday by Mr. tead and others. It may be estimated at 300 feet above the lake, ɔep ascent. The rock near the lake consists of imperfectly-formed with a semi-vitreous fracture, but bearing marks of the original ation of the sandstone from which it was derived. Higher up the s rock is granular, showing the rounded particles and original struc-

ture of the sandstone. Above this the metamorphic chlorite slate appears mixed with particles of quartz more or less largely, so as to form a peculiar breccia. Through this the vein of quartz runs, course probably NNW., breadth about 2 feet 3 inches. It contains large threads and bunches of sulphuret of copper and iron, easily cut with the knife; also, sulphuret of iron, and gray or black sulphuret of copper, distinct. The rock is easily broken, and the ore appears rich: specimens taken. The richness of these quartz veins in the metamorphic rocks may cause greater importance to be attached to the similar ores which occur in the Carp river region.

August 21.—Head of the Upper Neebish rapids, at the outlet of Lake George, Canada side; metamorphic sandstone; a quartz rock regularly stratified, dip 23° SW.; many of the strata deeply ripple-marked; one observed with very fine ripple-marks, parallel, and less than an inch apart. The structure of the rock is granular, with rounded transparent grains, the interstices filled with a white amorphous quartz—the whole, under the microscope, resembling the appearance of sandstone so much as to leave no doubt of its origin, independent of other indications. Specimens taken.

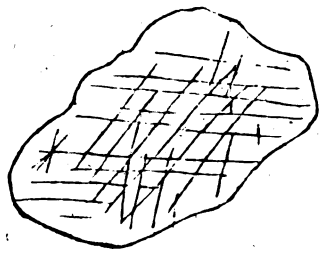
Eight miles below the above, trap observed, which then occurs continuously to within two miles of Bruce's mine, fifteen miles below the rapids, where we camped. The trap islands, when small, are occasionally worn very smooth, and finely marked with "drift scratches." Direction, as taken from the boat, NW. and SE.

August 22.—Bruce's mine; veins of quartz in hornblendic trap; many thread veins of quartz, and two or three more large veins; the vein opened for the greatest length, varying from two to three feet in breadth; very rich in yellow sulphuret of copper and iron, which is distributed in large bunches and threads, and also in the purple sulphuret, of which very fine specimens can be obtained. Specimens of these taken. Course of this vein nearly NW. and SE., but tortuous. Mine distant, by estimate, 250 or 300 yards from the shore, where another quartz vein is seen; the rocks at the mine scratched in a direction nearly N. and S.; and on the shore, and at an island connected with the shore by a bridge, the direction of the scratches was accurately taken, N. 10° E. At the mine, and also on the shore, large and abundant boulders occur of metamorphic sandstone quartz, with occasional boulders of *metamorphic conglomerate*, in which the original grains of the sandstone can be traced, as in the sandstone quartz described at the Upper Neebish rapids. The pebbles are converted into jasper or hornstone, or, where originally silicious, are yet distinguishable by their appearance from the quartz surrounding them.

The abundance of these boulders shows their origin not to have been far distant, and doubtless in the direction of the "drift scratches," nearly north, in the metamorphic sandstone region of the Upper Neebish rapids. This is the final and complete identification of the stratified and granular quartz with the sandstone formation above—having its granulation, its ripple-marks, and its occasional strata of conglomerate. It should have been stated that a large boulder at the mine was found, consisting of sandstone quartz, with two thin strata of pebbles running through it, closely resembling the sandstone of "Grand Portal."

In connexion with the "drift scratches" on the trap rocks, the boulders on the shore are much scratched, frequently in a single direction, showing

have been fixed when the marking took place; but occasionally, th two or three systems of scratches, thus,



l directions.

ragments of trap about the mine occasionally present a very regu- nnar structure. Similar ones are also seen upon the shore.

t 23.—A mile and a half or two miles up the river from the Bruce nestone comes in on the east shore. It is much ruffled and con- general course N. 35° E.; dip 37° (E. 35° S.?) Color of lime- hite, with blue or gray veins, which are much harder than the estone, and effervesce less, or not at all. These project from the forming curious ruffles or fringes.

point one mile above, Mr. Keating states that the metamorphic erate is found in place.

point $\frac{1}{16}$ of a mile below the one first described, a trap dike, 12 e, cuts through the limestone; course E. 10° N. The limestone urse here east and west, ridged and striated. Dip nearly vertical. e next point below, the same trap dike cuts across, with a vein of slate interposed between it and the limestone.

slate is very soft, and is used by the Indians for pipes. Width of or two feet. The limestone at this point light gray, very si- n appearance, and does not effervesce with acids. It is said to ood lime, but little of it."

seph's island, a little north of the Bruce mine on the opposite mestone, bearing E. 40° S.; dip 2° (S. 40° W.;) fossils abundant. taken in another position, E. 25° S. A large number of speci- ten by Dr. Locke.

t 24.—Same locality. In the morning a large number of fossils, g several varieties of trilobites, collected. The shore covered with s of limestone, somewhat water-worn. Boulders of trap and of phic conglomerate also occur. The limestone continues to appear two miles southward, after which nothing but boulders are visible ore of St. Joseph's, to its southern termination.

ed at Drummond's island, U. S., and coasted half a mile on its shore, going south. Limestone glittering, and crystalline of a h gray color, containing numerous cavities. Fossils abundant, erved by Dr. Locke.

t 25.—Coasting along Drummond's island towards the Detour, e. In the bay containing the old British fort, at the SW. side of d, opposite the Detour, the parade of the fort consists of a terrace of e, inclining, at a very small angle, to the water. It affords a good ity to get the bearing and dip of the strata on a large scale. The is W. 35° to 40° S. The dip 1° or 2°, (S. 35° to 40° E.)

August 26.—Island about half way between the Detour and Mackina No rocks observed in place, but limestone boulders and angular d abundant. Fossils few, observed by Dr. Locke. Islands and sh from the Detour westward, sandy, with points to the south rocky a shoal.

August 28.—Mackinack arched rock, fossiliferous limestone. The li stone abounds in cavities and clefts; some of them large enough to be c sidered caves. To this structure the arched rock, and passage beneath are, undoubtedly, due. The rock is a breccia, composed of a bluish g or gray limestone, including angular fragments, often parallelograms, o whiter variety. At the time this breccia was formed, various fissures a cavities seem to have had their origin, and these are lined with crystal carbonate of lime, of which specimens were taken. Small seams of wh crystalline carbonate of lime also occasionally run through the ro Occasional nodules of chalcedony also occur—in some, if not in all ca consisting of fossils. The cavities in the rock are due at least to t sources: 1st, cavities of original structure, and crystallization; 2d, to sion by weather, which, from the abundant fissures, has free acces the interior of the rock; 3d, to decay of the white included fragments of breccia, which seem easily decomposable and leave moulds of their shap the original rock; 4th, to the cavities of fossils. The whole structure of th rocks is very loose, portions crumbling every year, under the influenc frost and other causes, so that the continuance of "the arched rock" any great length of time is improbable or uncertain. The arched roc a slender span of rock, connecting two portions of the cliff at a heigh about 100 (?) feet above the water, and is justly considered one of natural curiosities of the island.

August 30.—Ledge a little to the NE. of the line connecting the old new forts. Limestone of the brecciated character of this island, contai a few shells. Loose fragments occur at its base, containing veins or ra es of chalcedony, rich in fossils. Specimens of these taken. A sin large fragment found on the crest of the hill on which the old fort sta

Sugar loaf rock, a conical rock of limestone, very much fissured full of cavities, two or three of which approach to caves in size, form an aperture through it, from side to side, and also communicating with light above. Its steepness makes it very difficult of ascent. Its heig considerably above the trees, estimated at 60 to 70 feet. Fossils found the loose fragments at its base.

"Standard Rocks."

No. 1.—"Augitic rock," range 26, township 47, section 18.
No. 2.—Red sienite, range 26, township 46, section 6.

A.

Copy of instructions to Dr. John Locke, assistant geologist.

SIR: In virtue of authority vested in me by instructions from the hon able Secretary of the Treasury of the United States, given April 16, 18 I hereby appoint you to be a first assistant geologist for the geolog survey of the mineral lands of the United States in the northern pe sula of Michigan. Your duties will commence on the first day of J

ou will be allowed, according to my instructions, five dollars per -you paying your proportion of the expenses of travelling and sub- g, on said survey, excepting the amounts paid in necessary trav- ; expenses from your home to Lake Superior, and for your return , which, according to my instructions, will be allowed you by the rnment. You will take charge of the magnetic observations required, rding to my instructions, in addition to your usual duties, as an as- nt geologist on the sections assigned to you.

is my wish that you should commence your surveys on the eastern of the mineral lands, near the Chocolate river, and that you should ore the country between the outlet of that river into Lake Superior the little Bay du Noquet; and that you should examine the ranges of nships from that range westward and ascertain the geological charac- of the country, denoting the limits of the rock formations and the ous fossils and minerals that occur, and particularly describing any s or beds of metals, or metalliferous ores, that may exist in your dis- t, remarking on their nature, situation, and the economical value of localities of veins or beds suitable for mining purposes. In connexion h the latter requirements, you will please to describe the course, dip, l width of every vein or bed you may discover, and ascertain the con- ons for drainage of a mine on said workable veins or beds. You will please to collect fair average specimens of the ores, metals, or rocks, l ascertain their specific gravity, in order to determine the weight of a ic foot of the ores or metalliferous lode. You will also please to notice character of the country, and remark on the feasibility of working the es you may propose should be wrought, and on the facilities of trans- ting the ores or metals to some convenient harbor on the naviga- waters of Lake Superior or Michigan, stating what conveniences e may be for the construction of roads, and the probable length of l that may be required. Please also to notice the nature of the wood able for making charcoal, or for furnishing timber, boards, and plank the buildings for mining establishments. Please also notice any good ities for quarrying suitable stone for furnaces, and any good deposites rick or fire-clay; also, any good limestone suitable for fluxes for ores opper and iron, or for making cements.

any district you may deem valuable as agricultural land, please col- air samples of the soils for chemical analysis.

calling your attention to the above mentioned particulars, I would ve that I do not wish in any way to restrict your observations, and ll be happy to receive communications of any other useful and in- ng facts you may notice during your survey. Your extensive ob- ions and long experience as a scientific geologist and naturalist will st to you many other interesting observations during your journeys e almost unexplored wilderness which we are called upon to ex-

h high considerations, I have the honor to be your obedient servant,

CHARLES T. JACKSON,

Geological Surveyor of the U. S. Mineral Lands of Michigan.

essor JOHN LOCKE.

Report on Magnetic Observations, by Dr. John Locke, assistant geologist.

FORT WILKINS.

July 5, 1847.—Latitude 47° 28′, longitude 88° 45″.

° ′ ″		h. min. sec.							
78 03 00		8 51 16 a.	1319.9	71.5	1318.9	17394972100	712.14	3439.3	1149.6

Geology.—Metamorphic conglomerate near to the trap.

HORSHOE HARBOR.

July 8, 1847.—Latitude 47° 28′ N., longitude 87° 57′ W.

° ′ ″		h. min. sec.							
78 15 05	5	9 20 04 a.	1690.4	81.5	1688	284934400	640.07		
	6	9 50 01.2	1686.0	88.5	1682	283912400	637.15		
							638.92	1339.7	1046.9

Geology.—Conglomerate.

EAGLE RIVER MINE.

June 30, 1847.—Latitude 47° 24′ N., longitude 88° 25′ W. Range 31, township 57, section 30; United States survey.

° ′ ″		h. min. sec.							
77 24 00	4	3 03 00 p.	1465.93	86.0	1463.45	21416859025	569.06		
	5	4 00 00	1791.22	87.5	1787.84	31963718656	570.83		
	6	4 40 00	1774 43	86.0	1770.37	31342099369	575.19		
							571.69	3106.8	1038.7

Locality.—In the ravine of the river, and at an angle opposite to an adit.

Geology.—[illegible]

EAGLE RIVER

° ′ ″ 77 39 00	4	h. min. sec. 5 35 00	1359.12	62	1358.95	18467451025	670.77	3136.1	1048.1

EAGLE RIVER MINE.

July 1, 1847.—On a hill about three-quarters of a mile west of the works, as by the previous latitude and longitude.

° ′ ″ 77 56 04	4 5 6	h. min. sec. 7 49 00 8 20 03.6 8 44 03.6	1370.72 1668.80 1662.40	71.5 74 74	1669.7 1667.16 1660.74	18760780990 27794224656 27580633476	660.29 656.50 653.68		
							656.82	3141.9	1050.1

Geology.—Feldspathic greenstone.

CLIFF MINE.

July 1, 1847.—Latitude 47° 24′ N., longitude 88° 26′ W. Range 32, township 58, section 36; United States surveys.

° ′ ″ 77 46 20	4	h. min. sec. 4 30 00	1380.33	53	1381	19867610000	649.67	3068.1	1025.4

Locality.—Inside of the mine.

Geology.—The instruments were placed on the immense mass of native copper which laid exposed in the gallery.

77 37 37	4	5 56 00 p.	1363.6	70	1362.72	1857776900	666.8	3111.4	1039.8

2d locality, outside of the mine and over the vein on the highest point of the ridge.—Geology trappean.

COPPER FALLS.

July 2, 1847.—Latitude 47° 27′ N., longitude 88° 12′ 30″ W. Range 31 W., township 58 N., section 11.

° ′ ″		h. min. sec.							
78 20 00	4	3 32 01.2	1538.36	69	1537.44	19146256900	647.0	3125.5	1044.6
Geology.—Over the vein of metallic copper.									
78 16 29	4	3 01 04	1372.8	76	1371.31	18804636700	658.75	3241.6	1083.2

2d locality, in a wood one-fifth of a mile below the falls.

BAIE DU GRIS—(*Encampment.*)

July 9, 1847.—Latitude 47° 24′ N., longitude 88° 06′ W. Range 29, township 58, section 34; United States surveys.

° ′ ″		h. min. sec.							
77 06 30	5	8 19 25 a.	1620.39	69	1619.37	26223591969	695.00	3115.1	1041.1

Geology.—Sandstone, very near to the trap.

SIBLEY'S MINE.—(*Lac La Belle.*)

July 8, 1847.—Latitude 47° 24′ N., longitude 88° 08′ W. Range 29, township 58, section 32; United States surveys.

° ′ ″		h. min sec.							
76 13 26	5	12 46 04	1557.36	77	1555.51	24195802500	754.1	3167.1	1058.5

BOHEMIAN MOUNTAIN.

July 9, 1847.—Latitude 47° 25′ N., longitude —. Range 29, township 58, section 29; United States surveys.

° ′ ″		h. min. sec.							
78 30 38	5	5 29 01 p.	1445.52	80	1443.52	20837499904	875.63		
	6	5 54 06	1440.34	77	1438.19	20683904761	871.59		
							873.61	4281.9	1464.6

Geology.—Sienite.

EAST AND WEST VEIN MENDELBAUM'S MINE.

July 10, 1847.—About half of a mile south of the Bohemian mountain.

89° 02′ Dipping needle vibrated 30 in one minute. This extraordinary result was obtained on a precipice looking southward, with a thin vein of blue sulphuret of copper traversing from east to west.
From the above, and from the vibrations of the same needle at Cedar swamp on the lake margin, we deduce the total intensity (see below) 1182.4.

CEDAR SWAMP.

At the landing of Sibley's mine, margin of Lac La Belle.

July 10, 1847.—Range 29, township 58, section 32. South part.

° ′ ″		h. min. sec.							
76 52 41	5	11 14 12	1617.38	82.5	1614.76	26074498576	699.8	3081.8	1030.00

The same needle which vibrated 30 in a minute at the above station, performed 28 vibrations in the same time. Of course, these are but approximations. They indicate a high intensity at the east and west vein.

Geology.—Sandstone very near to the sienite, which rises very precipitously to the north.

MOUNT HOUGHTON.

July 10, 1847.—Latitude 47° 25 N., longitude 88° 04′ W. Range 29, township 58, section 32; United States surveys.

° ′ ″		h. min. sec.						
77 28 00	5	5 31 01 p.	1636.39	80	1634.10	26702828100	683.4	3149.2	1052.5

Geology.—A broad vein of red jasper.

BAIE DU GRIS—(*Western point.*)

July 12, 1847.—Latitude 47° 22′ N., longitude 88° 05′ W. Range 29, township 57, section 14.

° ′ ″		h. min. sec.						
77 25 26	5	7 45 03	1640.39	75	1638.67	26852393689	679.48	3120.9	1043.1

Geology.—Sandstone, nearly horizontal.

SOUTH PART OF POINT KEWENON.

July 12, 1847.—Latitude 47° 26′ N., longitude 87° 51′ W. Range 27, township 58, section 27.

° ′ ″		h. min. sec.						
78 30 39	5	1 45 01 p.	1689.6	87	1686.4	28439449600	641.57	3222.7	1077.1

Geology.—Sandstone, near the junction of trap.

NE. angle, about 2 miles N. of the preceding.—July 18, 1847.

° ′ ″ 78 11 30	5	h. min. sec. 5 24 05 a. m.	1696.4	60	1696.4	287777296	634.03	3099.	1035.7

Geology.—Vesicular and amygdaloid trap, containing agates.

TRAVERSE, PRESQ'ISLE.

July 18, 1847.—Latitude 47° 11′ N.; longitude 86° 23′ W. Range 31, township 55, section 16; United States surveys.

° ′ ″ 77 08 29	5	h. min. sec. 5 25 02 a. m.	1631.4	64	1630.83	26596064889	686.04	3092.7	1030.3

Geology.—Horizontally stratified sandstone.

MOUTH OF PORTAGE RIVER, OR "ENTRANCE."

July 18, 1847.—Latitude 47° 01′ N.; longitude 88° 30′ W. Range 33, township 53, section 13.

° ′ ″ 77 00 30	5	h. min. sec. 2 58 04 p.	1620.8	74	1619.2	26217086400	695.95	3098.7	1035.6

Geology.—Horizontally stratified sandstone.

ANSE.

July 19, 1847.—Latitude 46° 49′ N.; longitude 88° 34′ W. Range 33, township 51, section 25; United States surveys.

° ′ ″		h. min. sec.							
76 51 34	4	4 31 03 p.	1329.68	76.	1328.39	17646199921	702.00		
	5	5 02 04	1613.52	74.	1611.94	25983505636	702.21		
	6	5 29 36	1607.58	72.5	1605.62	25786578724	698.35		
							700.85	3082.6	1036.7

Geology.—Horizontally stratified sandstone.

MOUTH OF HURON RIVER.

July 21, 1847.—Latitude 46° 56′ N.; longitude 88° 09′ W. Range 29, township 52, section 18 (?)

° ′ ″		h. min. sec.							
77 10 48	5	8 04 02 a.	1630.4	73	1629.0	26536410000	687.58	3099.5	1036.9

Geology.—Sand, probably superimposed on horizontally stratified sandstone.

MOUTH OF DEAD RIVER.

July 23, 1847.—Latitude 46° 34′ 17″ N.; longitude 87° 33′ W. Range 25 N. 4th correction line, township 48, section 12.

° ′ ″		h. min. sec.							
77 16 36	4	9 50 00	1355.72	80.	1353.96	18332076816	670.27		
	5	10 21 02.8	1646.40	79.5	1644.1	27030648100	671.31		
	6	10 47 01	1642.00	80.	1641.1	269320921000	669.39		
							670.32	3042.1	1017.3

July 26, 1847.—Latitude 46° 30′ N.; longitude 87° 42′ W. Range 26, township 48, section 25, S W. part.

° ′ ″		h. min. sec.							
77 01 26	5	7 15 05.6 a.	1624	61	1624.3	26283504900	691.56	3080.0	1029.4

Geology.—Metamorphic sandstone.

IRON MOUNTAIN.

July 26, 1847.—Latitude 46° 27′ N.; longitude 87° 49′ W. Range 27, township 47, section 1.

° ′ ″		h. min. sec.							
77 58 10	5	3 05 03 p.	1698.4	60	1698.4	28835125600	632.78	3035.2	1014.4

Geology.—Anhydrous peroxide of iron.

LOADSTONE ENCAMPMENT.

July 27, 1847.—Latitude —; longitude 87° 44′. Range 26, township 47, section 18.

° ′ ″		h. min. sec.							
42 53 00	5	10 16 00	822.00	60	822.00	65963284	2766.0	1261.6	

Geology.—A loadstone in place, broken mostly into sharp angular fragments. Here were two poles, 17.67 feet apart—one attracting the north, and the other the south pole of a magnetic needle.—(See notes.)

EAST BRANCH OF THE ESCONAWBY.

July 28, 1847.—Latitude 46° 24′ north; longitude 87° 47′ west. Range 26, township 46, section 6.

° ′ ″		h. min. sec.							
76 14 21	4	9 41 01 a.	1304.3	62	1304.13	17007550569	728.36	3062.6	1023.6

Geology.—Probably sienite.

FALLS OF EAST BRANCH OF ESCONAWBY.

July 29, 1847.—Range 26, township 46, section 30.

° ′ ″		h. min. sec.							
76 39 00	5	7 58 08 a.	1601.4	60	1601.4	25644819600	715.39	3098.3	1035.5

Geology.—Porphyritic sienite.

TRAIN RIVER.

August 7, 1847.—Latitude 46° 30′ north; longitude 87° 01′ west. Range 20, township 47, section 32.

° ′ ″		h. min. sec.							
76 41 37	5	6 52 32 a.	1593.63	55	1594.18	25414098724	717.95	3118.7	1042.4

GRAND ISLAND.

August 8, 1847.—Latitude 46° 27′ north; longitude 86° 45′ west. Range 19, township 47, section 22, at the point west of Williams's.

		h. min. sec.							

August 11, 1847.—Latitude 46° 48′ north; longitude 86° 49′ west. Range 18, township 48, section 35.

° ′ ″		h. min. sec.							
77 11 30	5	5 37 02	1618.3	62	1618.08	26181826864	696.98	3143.7	1050.7

August 11, 1847.—AT THE CAVE OF PORTAL ROCK, (*about ¼ of a mile to the northwest of the preceding.*)

° ′ ″		h. min. sec.							
77 12 48	5	9 48 02.4	1621.61	64	1621.16	26281597456	694.27	3139.8	1049.4

Geology.—Horizontal sandstone.

GRAND MARAIS, EAST POINT.

August 12, 1847.—Latitude 46° 42′ north; longitude 86° 09′ west. Range 13, township 49, section 4.

° ′ ″		h. min. sec.							
77 18 03	5	8 57 04 a.	1631	64.5	1630.5	26574216256	686.61	3123.2	1043.6

NEAR DOUBLE HEART RIVER.

August 13, 1847.—Latitude 46° 43′ north; longitude 85° 38′ west. Range 10, township 49, section 1.

° ′ ″		h. min. sec.							
77 31 07	5	5 21 00 a.	1636.0	64.5	1635.5	26748602500	683.13		
	6	5 50 08	1632.2	66.5	1631.94	26616702056	677 41		
							679.72	3116.5	1041.5

TWO MILES WEST OF WHITEFISH POINT.

August 13, 1847.—Latitude 46° 46′ N.; longitude 85° 13′ W. Range 6, township 51, section 31.

° ′ ″		h. min. sec.							
77 32 00	5	8 50 00.8	1639.6	65	1639	2686390000	679.22	3146.4	1051.6

LITTLE TAQUAMANON RIVER.

August 14, 1847.—Latitude 46° 41′; longitude 85° 13′ W. Range 6, township 49, section 3.

° ′ ″		h. min. sec.							
77 19 30	5	4 46 09	1634.4	78	1632.47	26549583009	637.24	3132.1	1046.8

ST. MARY'S RIVER—(*Opposite Palmer's*)

August 20, 1847.—Latitude 46° 32′ N.; longitude 84° 24′ W. Range 2, township 48, section 29.

° ′ ″		h. min sec.							
77 23 15	5	8 33 15	1637.1	69.5	1637 01	26800964100	680.61		
	6	8 02 03	1681 2	66.5	1639.46	26583998116	678.19		
						Mean.....	679.00	3109.6	1039.3

DRUMMOND'S ISLAND.

August 25, 1847.—Latitude 46° 00′ N.; longitude 84° 03′. Range —, township 42, section 31.

° ′ ″		h. min. sec.							
77 06 34	5	11 48 03	1623.6	79 5	1621.44	26290376736	694.02		
	6	11 26 00	1617.6	79.0	1614.90	26079037636	691.27		
						Mean.....	692.64	104.5	1037.6

BRUCE'S MINE—(*At the landing.*)

August 22, 1847.—Latitude 46° 19′ N.; longitude 83° 58′ W.

° ′ ″		h. min. sec.							
77 02 32.5	5	6 28 02	1624 6	63	1624.26	26382205476	691.60		
	6	6 47 03.8	1614.6	60	1614.60	26069331600	691.54		
							691.58	3084.1	1030.7

Geology.—Over a trappean dike, and near the lake.

BRUCE'S MINE.

August 23, 1847.—Near the principal vein of ore.

° ′ ″		h. min. sec.							
77 16 00	6	6 16 02 a.	1649.6	56	1650.18	27230940324	662.04	3003.6	1004.9

BRUCE'S MINE.

At the basaltic bluffs, 40 rods N. of the mine.

° ′ ″		h. min. sec.							
74 24 22	6	9 51 01 a.	1485.6	68	1484.56	22000371600	819.43	3049.5	1019.2

Geology.—Pieces of basaltic rock decidedly magnetic.

ISLAND FIVE OR SIX MILES NORTH OF MACKINAW.—(*St. Martin's island?*)

August 28, 1847.—Latitude 45° 59′ N., longitude 84° 47′ W. Range 2 W., township 41 N., section 9.

° ′ ″		h. min. sec.							
76 43 30	4	3 18 02 4	1318.88	66	1318.34	17380203556	712.74		
	5	3 42 24 p.	1599.61	66	1598 94	25566091236	713.68		
	6	4 05 05 p.	1590.82	64	1590.25	25289268676	713.26		
							713.22	3106.0	1038.1

Geology.—Cliff limestone, horizontally stratified.

TWENTY-FIVE MILES WEST OF MACKINAW.

September 3, 1847.—On the lake shore, latitude 46° 03′; longitude 85° 21′. Range 7 W., township 42 N., section 12; United States surveys.

° ′ ″		h. min. sec.							
76 55 31	5	1 40 04	1609.6	67	1608.81	25882274400	704.96		
		2 02 01.6	1602.6	66	1601.75	25656030625	709.67		
							708.82	3111.1	1039.0

MOUTH OF SEUL CHOIX RIVER.

September 6, 1847.—Latitude 45° 59′ N.; longitude 86° 8′ W. Range 13, township 40, section 11.

° ′ ″		h. min. sec							
76 35 15	5	9 38 04 a.	1589.62	67	1588.74	25240947876	722.87	1041.3	

Geology.—Cliff limestone.

SEVEN MILES WEST OF SEUL CHOIX POINT.

September 8, 1847.—Latitude 45° 58′ N.; longitude 86° 15′ W. Range 14, township 41, section 10.

° ′ ″		h. min. sec.							
76 25 37	5	12 42 44	1590.62	60	1590.62	25300719844	721.17		
	6	12 57 59.2	1581.62	60	1581.62	25005096900	729.82		
							720.99	3071.8	1026.6

Geology.—Sand, superimposed on cliff limestone.

MINISTIQUE RIVER.

September 9, 1847.—Latitude 45° 58′ N.; longitude 86° 29′ W. Range 26 W., township 41, section 18.

° ′ ″		h. min sec.							
76 24 09	4	6 16 04 p.	1303.7	60	1303.7	16997336900	728.79		
	5	5 49 05	1581.62	60	1581.62	25015218244	729.40		
	6	5 31 00	1574.62	61	1574.50	24790502500	727.21		
							728.47	3098.0	1035.4

Geology.—Sand, superimposed on cliff limestone.

MOON ISLAND.

September 11, 1847.—Latitude 45° 36′ N.; longitude 87° 17′ W.

° ′ ″		h. min. sec.							
76 18 40	5	11 31 08 a.	1580.62	64	1580.22	24964000000	730.7		
	6	11 59 01.6	1574.62	65.5	1574.02	24774760000	727.6		
							729.15	3080.5	1029.6

Geology.—Sand, superimposed on cliff limestone.

Classification and comparison of the preceding results.

KEWENON PENINSULA.

	Latitude.	Longitude.	Total intensity.
	° ′ ″	° ′ ″	
lkins	47 28	88 00 45	1149.6
ioe Harbor	47 28	87 57	1046.9
ver Mine	47 24	88 25	1038.7
o	47 24	88 24 45	1048.1
o	47 24	88 26	1050.1
ne	47 24	88 28	1025.4
o	47 24	88 28	1039.8
Falls	47 27	88 12	1044.6
o	47 26 50	88 12	1083.2
Gris	47 24	88 06	1041.1
Mine	47 24	88 08	1058.5
n Mountain	47 25	88 08	1464 6
aum's	47 24	88 08	1182.4
near Sibley's	47 23 40	88 08	1030
Houghton	47 25	88 04	1052.5
n point of Baite du Gris	47 22	87 51	1048.1
ewenon	47 26	87 50	1077.1
Do	47 28	87 50	1035 7
Bill	47 11	87 30	1030.3
of Portage river	47 01	87 30	1035.6
	46 49	87 34	1036.7
Mean	47 22 36	88 13 24	1077.1
tal intensity reduced to arbitrary scale			1.9334

ARKS.—In April, 1844, I announced to the American Philosophical Society, that at Point on I had probably reached the place or region of maximum intensity; at the same ualifying that announcement on account of the want of more extended and multiplied h.

Since Captain Lefroy has examined the region between Lake Superior and Hudson bay, Colonel Sabine has calculated the maximum to be 1.878, and located in latitude 52° 19′ and longitude 91° 59′.

The high intensity of Point Kewenon—determined by numerous observations made over a region of thirty miles in extent—must, then, be considered a case of extraordinary and extensive local attraction, the mean being higher than Colonel Sabine's maximum. Indeed, the abrupt changes and extraordinary results along the trappean dikes and near the metallic veins are sufficient evidence of unusual magnetic forces, although they operate on a scale co-extensive with the peculiar geological formations of trap and metalliferous conglomerate, occupying so large a portion of that peninsula.

If, however, we select such observations as were made on the horizontally stratified sandstone of the peninsula, we find them not only consistent among themselves, but conforming to the results which Captain Lefroy obtained between Lake Superior and Hudson's bay. They are as follows:

	Latitude.	Longitude.	Total int'y.
Baite du Gris - - -	47° 24′	88° 08′	1041.5
Do western part -	47° 22′	88° 05′	1048.1
Hawk's Bill - - -	47° 11′	88° 30′	1030.3
Portage river - - -	47° 01′	88° 30′	1035.6
Anse - - - -	46° 49′	88° 34′	1036.7
	47° 09′ 06″	88° 21′ 06″	1038.3
Total intensity, reduced to arbitrary scale - - -			1.8637

The observations at La Pointe and at Ontonagon river were made on the same sandstone. The results are as follows:

	Latitude.	Longitude.	Total int'y.
La Pointe - - -	46° 47′	90° 58′	1044.5
Ontonagon river - -	46° 52′	89° 31′	1039
	46° 49′ 30″	90° 44′	1041.7
Reduced to arbitrary scale, total intensity - .			1.870

South shore of Lake Superior, from Chocolate river to Taquamanon.

	Latitude.	Longitude.	Total int'y.
Train river - - -	46° 30′	87° 01′	1042
Grand island - - -	46° 27′	86° 45′	1045
Chappel river - - -	46° 43′	86° 40′	1049
Portal Rock - - -	46° 43′	86° 39′ 45″	1049
Grand Marais - - -	46° 42′	86° 09′	1043
Two-heart river - -	46° 43′	85° 38′	1041
Near White Fish point -	46° 46′	85° 13′	10
Little Taquamanon river -	46° 41′	85° 13′	1046
	46° 39′ 22″	86° 09′ 50″	1045.875
By arbitrary scale - - - - -			1.877
Maximum of Colonel Sabine - -			1 878

These observations, which are remarkably consistent and made along a sandstone coast entirely unexceptionable as regards the geological formations, exhibit a mean within a unit of being equal to the maximum of Colonel Sabine. Why it should be higher than a mean of the most unexceptionable observations on Kewenon peninsula, it is difficult to decide, unless the cold water of the lake, extending along so nearly a magnetic parallel, has some modifying influence.

It appears that the intensities, as indicated by No. 5, are higher than the mean where the three needles have been used. In order to be able to apply an equation where No. 5 alone was used, I have made comparisons of nine cases in which two or three needles were used. I find by the mean of this comparison that the ratio of the indications of No. 5 to those of the means of the several needles, is as 1 to 0.99852. The mean of total intensity at eight stations along the south shore of Lake Superior, from Train river to Little Taquamanon, by No. 5, is equal to 1046, or by arbitrary scale 1877.6, which being reduced by the above co-efficient, is 1874.8.

Synopsis of the explorations of the geological corps in the Lake Superior land district in the northern peninsula of Michigan, under the direction of J. W. Foster and J. D. Whitney, United States Geologists.

BOSTON, *November* 5, 1849.

SIR: In accordance with our instructions, we hasten to communicate to you a synopsis of the results of the explorations of the geological corps under our superintendence in the Lake Superior land district during the past season.

On receiving our instructions from the department, we proceeded forthwith to make the necessary preparations for taking the field. We were particularly required to designate, as soon as possible, by quarter sections, such tracts as, in our opinion, ought to be reserved as "mineral lands," in order to enable the department to carry out the provisions of the act of March 1, 1847, entitled "An act to establish a new land district, and to provide for the sale of mineral lands in the State of Michigan."

Mr. S. W. Hill, of Eagle River, Michigan, whom we had appointed assistant geologist, was instructed to procure the necessary assistance, and proceed at once to explore the trap range of Keweenaw point with sufficient minuteness to enable him to designate the character of each quarter section. He entered upon the work early in June, immediately after the disappearance of the snow, and carried it on with zeal and vigor until the requisite information had been obtained.

Anxious to avail ourselves of the services of one who had extensively traversed this region, and possessed a large fund of local information, we tendered to Mr. John Burt, United States deputy surveyor, of Mount Vernon, Michigan, the post of assistant geologist; but unfortunately Mr. Burt had entered into a contract for linear surveys, which he was under obligations to fulfil. This post was subsequently filled by Mr. E. Desoo, a gentleman well known to the scientific world. He had thoroughly investigated the superficial deposites of northern Europe, which present many points of resemblance to those of our own country; and we deemed

ourselves fortunate in having secured his services in this department of geology.

Messrs. William Schlatter and W. D. Whitney were appointed sub-assistants; the former was employed as draughtsman, the latter as ornithologist and botanist. It gives us pleasure to add that all of the members of the corps have devoted themselves actively to the interests of the survey, and discharged their respective duties with zeal and fidelity.

On arriving at Copper Harbor, we found that Mr. Hill had nearly completed the work assigned him. The whole corps was then transferred to the region west of Portage lake, to complete the examination of that district, which had been before explored by Mr. Whitney. Three parties were organized: one party explored the sources of the Elm and Misery rivers, and thence east to Portage lake; another party extended these explorations westwardly to the Ontonagon river; while the third traversed the mineral region west of that river. The heights of the principal points were measured with the barometer, and numerous specimens illustrative of the geology of the region collected.

On returning to Copper Harbor, while waiting for a vessel to convey us to Isle Royale, the maps of Keweenaw point and of the district between Portage lake, on which the character of each quarter section was indicated, were completed. Lists of the mineral lands were also made out, all of which were forwarded to the department at Washington. We availed ourselves of this interval to re-examine the principal mines of Keweenaw point, and collect samples of their products.

We next proceeded to Isle Royale, and commenced the examination of that island. We explored along its shores and in the interior. The heights of the principal ranges were determined, and several sections made across it. Owing to the great difficulty of effecting an exploration of the interior, little has as yet been done towards the development of its mineral resources except along its shores, and we found it impossible, in the limited time allotted us, to carry out a detailed investigation. We have, however, we believe, accomplished all that the interests of the government required. To Messrs. Douglass, Whittlesey, and Shaw, (the latter of whom accompanied us in part of our explorations,) we are indebted for much valuable local information.

Having accomplished this work, we were conveyed, on board of the propeller Napoleon, without delay, to Carp river. Our object was to examine that portion of the southern coast known as the "iron region." Four parties were organized, to each of which a particular district was assigned, with instructions to examine with care all of the localities of iron designated in the notes of the linear surveyors. The region was examined with sufficient minuteness, it is believed, to enable us to trace the boundaries of the several formations, and indicate the really valuable deposites of iron. Our operations here, however, were retarded by the sickness of several members of the corps.

On the completion of this work, a party under the direction of Mr. Hill was directed to coast along the shore to Keweenaw point, examining the Huron mountains on the route; and after arriving at L'Anse, to proceed inland to Sturgeon river, with a view of determining the age, position, and extent of the limestone which there occurs in connexion with the sandstone. After having arrived at Keweenaw point, he was further instructed to visit the Ontonagon river, and re-examine some of the mines

in that vicinity, which were but imperfectly developed when we were there in the early part of the season. The notes of this party have not yet been received.

Another party under Mr. Whitney coasted to Sault Ste. Marie, making excursions inland with a view of determining the boundaries of the detrital rocks, and taking sketches and measurements of the Pictured rocks and other objects of interest.

While at Sault Ste. Marie, in accordance with the instructions of the department, we furnished the receiver of the land office at that place with lists and diagrams of the tracts supposed to contain copper.

Such is a brief abstract of our explorations during the past season. The results of those explorations will be found in the four geological maps forwarded to the department:

1. A map of the region between Portage lake and the Montreal river.
2. A map of Keweenaw point.
3. A map of Isle Royale.
4. A map of the region between Keweenaw bay and Chocolate river.

These maps form a connected series, and embrace all of the mineral lands contained in the several townships subdivided up to the close of the year 1848. The southern extension of the metamorphic rocks, embracing the region about the outlet of the Machigamig and the upper portion of the Menomonee rivers, contains iron; but its range and extent has not been determined. This region was traversed by Messrs. Foster and Hill in the fall of 1848. It was being subdivided during the past season, and we deemed it advisable to defer its examination until we could avail ourselves of the township plats.

To Mr. Lyon, surveyor general at Detroit, we desire to express our thanks for his promptitude in furnishing us copies of plats, field-notes, &c., and other facilities he has afforded us in the prosecution of this work.

In the selection of the mineral lands, we have been governed by the following principles:

1. Tracts supposed to contain copper—in some cases associated with silver.

a. Experience in mining, and the examination of a great number of localities, have demonstrated that the veins of copper, and its ores, in the sandstone and conglomerate, are not to be relied on, and that when worked, even to an inconsiderable depth, they give out. Numerous trials have been made in these rocks, in the Lake Superior district, and the result in every instance has been unsuccessful. Although copper is found at short intervals, from the Pictured rocks to the Montreal river, in this rock, yet we have designated no tract in it as mineral land. As all of the productive lodes are confined to the ranges of trap, all of the mineral tracts designated lie within those ranges. What is generally known as the trap range, consists of a belt of igneous rocks, composed for the most part of hornblende and felspar, which in places have broken through the sandstones, tilting them up at high angles; but oftener are found in alternating beds, having the same dip as the detrital rocks. The associated sandstone and conglomerate belong to the silurian system, and rest at the base of all the fossiliferous rocks. The trap-range extends from the Montreal river—the western boundary of the district—and disappears in the lake at the extremity of Keweenaw point. Its general

course is a little north of east, preserving a pretty uniform parallelism with the southern coast of Lake Superior. Its width varies from two miles to twelve. Throughout this range—nearly one hundred and fifty miles in extent—copper, mostly native, is disseminated, but more profusely in some places than others. In fact, there may be said to exist two centres of metallic riches, around each of which copper has been accumulated in considerable quantity, but under circumstances somewhat different. The one may be designated as the Keweenaw point centre, which has a system of veins cutting across the trap range. Within this system are included the Cliff, North American, Northwest, Northwestern, and Copper Falls mines.

The other may be designated as the Ontonagon centre, and here the veins preserve a certain parallelism with the ranges, or run with the formation. In this system are included the Minnesota, the Ontonagon and the Ohio trap-rock mines.

Some of these accumulations of copper are mere beds, the result of segregation, while others are contained in fissures, formed subsequent to the containing rock, and associated with a veinstone entirely dissimilar.

It will thus be seen that the copper-bearing rocks form two independent groups, which are characterized by peculiarities distinctly marked.

b. Having restricted the mineral lands to the trappean rocks, and having traced on the maps the respective limits of the igneous and aqueous formations, it remained to be determined what portion of this belt should be reserved as mineral, and what excluded. The rocks over a large portion of this area are concealed by accumulations of transported matter—such as sand and clay, which sustains a dense growth of trees. The humidity of the climate is favorable to the production of mosses which cover the ground like a carpet; hence, to trace the boundaries of the rocks, even, is a task of great difficulty. The veinstone of the copper lodes, disintegrating more readily than the enclosing walls, becomes concealed by rubbish, even where the rock is exposed; hence its course is to be traced by observing the depressions in the soil. Most of the veins thus far tested have been found in precipitous cliffs, or in the beds of streams, where the water has swept away the superficial covering. When we consider the limited space occupied by these lodes—the most productive ones rarely exceeding two feet in width—and the difficulties attending their exploration, it must be acknowledged that a long interval of time will elapse before even a tithe of the mineral wealth of this region is revealed. Every road that is made, every well that is sunk, every pit that is excavated, every field that is cleared, will tend in some degree to develop its geology. If the country were opened, and the principal veins laid bare, it would be a task of some delicacy to determine which would prove productive and which not. The testing of veins in all mining countries is among the heaviest items of expenditure. Within the space of twenty years the consolidated mines in Cornwall have expended not less than £300,000 for the sole purpose of discovery, and their underground operations in sinking and driving amounted to about 63 miles.

It is evident, therefore, that it would have been impossible for us to designate such tracts, and such only, as contained productive veins. We have, therefore, designated as mineral those tracts lying in the cop-

r-bearing range, where rocks are exposed, and which, by their proximity to mines of known value, or by general comparisons of the indications of mineral wealth throughout the district, seem to offer a reasonable prospect of successful mining, and where minute explorations might reveal the existence of valuable lodes. In those portions of the district where the rocks are but imperfectly exposed and traversed by few veins, affording little encouragement for the prosecution of mining operations, we have reported no mineral tracts. Such is the character of the trap range to the west of Portage lake, as far as township 52, range 37 west, and of the region known as the Porcupine Mountains.

In designating the mineral lands on Isle Royale, we encountered still greater difficulties. It would be almost impossible to exaggerate the physical obstructions to a thorough exploration of that island. It may be characterized as a succession of ridges and swamps, densely covered with trees and shrubs. Fires have extended over a large portion of the island, and the fallen trunks form an almost impenetrable net-work of interwoven branches. We crossed the island in many places; but in these explorations we saw few evidences of veins.

We have little confidence in the metalliferous character of the veins on Isle Royale. That portion of the island embraced in the igneous formation is made up of alternating beds of hard crystalline greenstone passing into porphyry and amygdaloidal trap; the former are thick, the latter hin. Where the veins pass from the soft into the hard rock, they are bserved to change in their productiveness and become narrow and inched, and in some cases present a mere fissure. The best mining round is on the southern portion of the island, near the junction of the ap and conglomerate. The rock is "rind," and can probably be penetated to the depth of two or three hundred feet before striking a greenone vein. Two systems of veins occur here—one longitudinal, the her transverse.

The same banded appearance, and the same phenomena with regard to ie productiveness of veins in their transition from a hard to a soft rock, ave been observed on Keweenaw point. The metalliferous belts there re, however, wider, and the mining ground more extensive. The best nines will probably be limited in their downward range. We selected as mineral lands such portions as afforded good exposures of the rock, believing that such portions as are purchased will be so, exclusively in reference to their mineral wealth.

2. In designating the lands containing iron we have encountered less difficulty. The beds are found on a scale of such magnitude, and the ore is of such purity, that it requires little search to discover them, and little caution in pronouncing on their value. This iron region is, perhaps, the most valuable and extensive in the world for the manufacture of the finer varieties of wrought iron and steel. When we consider the immense extent of the district, the mountain masses of ore, its purity and adaptation to the manufacture of the most valuable kinds of iron, and the immense forests which cover the surface suitable for charcoal, this district may be pronounced unrivalled.

On referring to the map which accompanies this synopsis, it will be seen that the iron occurs in a metamorphic formation bounded by two granite belts—one on the north, and the other on the south—and that it is prolonged westerly beyond the Machigamig river. This formation

consists of hornblende, talcose, and chlorite slates, with associated beds of hornblende and felspar rocks evidently trappean in their origin. In that portion of the region drained by Carp and Dead rivers, and even on the head-waters of the Escanäba, the trappean rocks rise in irregular knobs and ridges from one hundred to two hundred feet above the general level of the country, and from eight hundred to ten hundred feet above the lake level. To the west and south of Machi-gummi, (or Big Lake,) the ridges are less abrupt, and there are some townships where there is scarcely a single exposure of the rock in place.

The ore consists mainly of the specular, or peroxide of iron, with an admixture of the fine-grained magnetic. In some instances the whole ridge (or knob) appears to consist of one mass of pure ore—so pure that no selection is required; but an unlimited quantity might be quarried, or picked up in loose blocks around the slopes; in others, the ore is mixed with seams of quartz or jasper, which renders it less valuable and requires some care in the selection. The iron in such cases presents a banded and contorted structure, or alternating seams of steel-gray and brilliant red. The appearance of a mountain-cliff thus made up is extraordinary.

In conclusion, it may be said that this region possesses an inexhaustible supply of iron ore of the best quality—removed from twelve to thirty miles from the lake shore, with a soil by no means sterile, and covered with a heavy growth of maple, yellow birch, pine, and oak—and that it is to this source that the great West will ultimately look for its supplies of the finer varieties of bar-iron and steel. The "Iron mountain" of Missouri becomes insignificant compared with these immense deposites. This region also contains extensive beds of marble, which will prove of much economical value for fluxing the ores and in yielding lime, while, with care, blocks for architectural and ornamental purposes can be obtained. Flesh-red is the prevailing tint with veins of a deeper hue. The novaculite slates are valuable, affording hones equal to the Turkey or Scotch stones.

Appended to this synopsis will be found complete lists of the mineral lands of the Lake Superior district.

During the past season the results of the mining operations in this region have been highly successful. Several companies are actively employed in prosecuting their works. The shipments of copper during the past year amount to about 1,200 tons, mostly in masses nearly pure. The Cliff mine, belonging to the Boston and Pittsburg Company, shows no signs of exhaustion; and its shipments during the present season amount to nearly 1,000 tons of copper, yielding about 90 per cent. It divided last year a dividend of upwards of 50 per cent. on the shares, and as large a dividend is expected on this year's product. The North American and the Northwestern Companies have now thoroughly opened their respective mines, and will probably, in the course of the next season, ship a considerable amount of copper.

The Minnesota mine, on the Ontonagon river, when we visited it in the spring, displayed a lode of unparalleled richness, and bids fair to rival the Cliff mine in productiveness. The shipments for 1850 will probably exceed 2,000 tons.

The mining operations in this region, prosecuted under many disadvantages, have shown that the veins of native copper are really valuable,

and as certain in their yield as those of the *ores* of copper, and that ultimately they will go far towards supplying the national consumption.

In the iron region the Jackson Company was the first to commence the manufacture of blooms and bar-iron. They have now two forges in successful operation, producing 2,400 pounds of blooms per day, at an expense of little over $21 per ton. Their forges are located on Carp river, about ten miles from the lake shore.

The Worcester Company, organized during the past year, have selected a site by the lake shore, about a mile above the mouth of the Carp river, and are erecting ten forges, which will be ready for operation by next year.

There is one obstacle which seriously retards the development of this region: we allude to the rapids of the St. Mary's river. These rapids are less than a mile in extent, and the fall varies between eighteen and twenty-one feet, dependent on the stage of water in Lake Superior. The banks, which nowhere attain an elevation of more than twenty-five feet above the bed of the stream, are composed of fissile sandstone. At present, every barrel of flour consumed in the mining region is carried over this portage, as well as every mass of copper or bloom of iron brought down. With this obstruction removed by the construction of a canal around the rapids, there would be an uninterrupted navigation from Buffalo and Chicago to Fond du Lac. The mining interest requires it. The fisheries, the immense tracts of pine and cedar, the various materials for construction, (such as granites, slates, and marbles,) would then all be made available, and it is believed that the government would be at once remunerated for the expense incurred by the enhanced value communicated to the public domain.

We purpose, during the ensuing winter, preparing a report on the economical geology of the region examined, giving a full description of the copper and iron-bearing districts, with delineations of the principal mines and all the data which we have been able to collect as to their productiveness, accompanied with plans of the workings, drawings of machinery, furnaces, and such other information as may be valuable to the mining population of that district.

What remains to be done is the examination of the southern extension of the iron region, which occupies but a limited area in the vicinity of the outlet of the Machigamig river and the upper part of the Menomonee, and the tracing out the boundaries of the limestones which form the northern shore of Lake Michigan. To accomplish this, we need about $3,000 in addition to the unexpended balance of the appropriation of 1847–'48. This work can be easily accomplished during the next season, when we shall be prepared to present a detailed and scientific report upon the whole region, with the necessary maps, on which will be indicated the boundaries of the various systems of rocks, and accompanied by analyses of all the useful minerals, soils, &c.

We have the honor to be, with great respect, your obedient servants,

J. W. FOSTER,
J. D. WHITNEY,
United States Geologists.

Hon. JUSTIN BUTTERFIELD,
Commissioner of the General Land Office, Washington.

List of the mineral lands in the region between Portage lake a Montreal river, Lake Superior land district.

Section.	Part.	Township north.	R
25	SE. ¼	52	
35	E. ½ and SW. ¼	.....	...
36	All	.....	...
1	NW. ¼	51	
2	N. ½ and SW. ¼	51	
10	E. ½ and SW. ¼	51	
11	W. ½	51	
15	N. ½ and SW. ¼	51	
16	S. ½	51	
21	All	51	
22	NW. ¼	51	
29	SW. ¼	51	
30	S. ½	51	
31	N. ½	51	
32	NW. ¼	51	
25	NW. and SE. ¼	51	
26	N. ½	51	
35	All	51	
36	N. ½ and SW. ¼	51	
1	SE. ¼	50	
10	S. ½	50	
11	S. ½	50	
12	N. ½ and SW. ¼	50	
13	NW. ¼	50	
14	N. ½ and SW. ¼	50	
15	All	50	
16	E. ½	50	
21	NE. ¼	50	
22	NW. ¼	50	
30	SW. ¼	50	
31	N. ½	50	
32	NW. ¼	50	
25	S. ½	50	
33	S. ½	50	
34	S. ½	50	
35	N. ½	50	
36	All	50	
4	N. ½	49	
5	All	49	
6	All	49	
7	N. ½	49	
1	E. ½ and SW. ¼	49	
2	S. ½	49	
3	SE. ¼	49	
10	NE. ¼	49	
11	N. ½	49	
12	N. ½	49	

List of the mineral lands of Keweenaw Point, Lake Superior district.

Section.	Part.	Township north.	Range west.
7	SW. ¼	58	27
17	W. ½	58	27
18	All	58	27
19	N. ½	58	27
20	NW. ¼	58	27
4	S. ½	58	28
5	S. ½	58	28
6	S. ½	58	28
7	All	58	28
8	All	58	28
9	All	58	28
10	All	58	28
13	All	58	28
14	N. ½ and SE. ¼	58	28
15	NE. ¼	58	28
16	S. ½	58	28
17	S. ½	58	28
18	SE ¼	58	28
19	NE. ¼	58	28
20	N. ½ and SE. ¼	58	28
21	All	58	28
22	W. ½	58	28
24	N. ½	58	28
27	NW. ¼	58	28
28	N. ½	58	28
1	S. ½	58	29
2	S. ½	58	29
7	All	58	29
8	All	58	29
9	All	58	29
10	S. ½	58	29
11	All	58	29
12	All	58	29
13	N. ½	58	29
14	N. ½	58	29
15	N. ½	58	29
16	N. ½	58	29
17	N. ½	58	29
18	N. ½	58	29
19	S. ½	58	29
20	S. ½	58	29
21	S. ½	58	29
22	S. ½	58	29
23	All	58	29
24	N. ½	58	29
25	N. ½	58	29
26	N. ½	58	29
27	All	58	29
28	All	58	29
29	All	58	29
30	All	58	29
31	N. ½	58	29
32	N. ½	58	29
6	NW. ¼	58	30
7	E. ½ and SW. ¼	58	30
8	All	58	30
9	All	58	30
10	All	58	30
11	All	58	30
12	All	58	30
13	N. ½	58	30
14	N. ½	58	30

List of the mineral lands of Keweenaw Point—Continued.

Section.	Part.	Township north.	R
15	All		
16	All		
17	All	58	
18	All	58	
19	N. ½	58	
20	NW. ¼	58	
25	All	58	
26	S. ½	58	
27	S. ½	58	
28	S. ½	58	
29	SE. ¼	58	
31	All	58	
32	All	58	
33	All	58	
34	All	58	
35	N. ½	58	
36	N. ½	58	
4	NW. ¼	57	
5	N. ½ and SW. ¼	57	
6	All	57	
11	SE. ¼	58	
12	S. ½		
13	All		
14	All		
15	S. ½		
19	S. ½ and N. E. ¼		
20	All		
21	All		
22	All		
23	All		
24	All		
28	NW. ¼		
29	W. ½ and NE. ¼		
30	All		
31	NW. ¼		
36	S. ½	58	
1	N. ½ and SW. ¼	57	
2	E. ½ and SW. ¼	57	
3	S. ½	57	
4	S. ½	57	
8	NE. ¼	57	
9	N. ½	57	
10	N. ½	57	
11	NW. ¼	57	
25	S. ½ and NE. ¼	58	
35	S. ½ and NE. ¼	58	
36	All		
1	N. ½	57	
2	All	57	
3	S. ½ and NE. ¼	57	
10	All	57	
11	W. ½	57	
15	W. ½	57	
16	SE. ¼	57	
21	All	57	
22	S. ½	57	
26	W. ½	57	
27	All	57	
28	N. ½ and SW. ¼	57	
29	E. ½	57	
31	E. ½ and SW. ¼	57	
32	W. ½	57	

List of the mineral lands of Keweenaw Point—Continued.

Section.	Part.	Township north.	Range west.
33	E. ½ and SW. ¼	57	32
34	W. ½ and NE. ¼	57	32
35	S. ½ and NE. ¼	57	33
36	SW. ¼	57	33
4	W. ½	56	32
5	S. ½ and NW. ¼	56	32
6	E. ½	56	32
7	N. ½ and SE. ¼	56	32
8	N. ½ and SW. ¼	56	32
17	W. ½	56	32
18	E. ½	56	32
19	All	56	32
20	W. ½	56	32
30	W. ½	56	32
2	W. ½	56	33
3	SE ¼	56	33
10	SW. and NE. quarters	56	33
11	N. ½	56	33
25	SE. ¼	56	33
35	SE. ½	56	33
36	All	56	33
1	NW. ¼	55	33
2	S. ½ and NE. ¼	55	33
3	SE. ¼	55	33
11	NW. ¼	55	33
10	S. ½ and NE. ¼	55	33
15	NW. ¼	55	33
16	All	55	33
20	S. ½ and NE. ¼	55	33
29	NW. ¼	55	33
30	N. ½	55	33
23	SE. ¼	55	34
24	N. ½ and SW. ¼	55	34
25	N. ½ and SW. ¼	55	34
26	All	55	34
27	SE. ¼	55	34
35	SE. ¼	55	34
36	S. ½	55	34

List of the mineral lands of Isle Royale, Lake Superior land dist

Section.	Part.	Township north.	R
3	N. ½	67	
4	E. ½	67	
21	SE. ¼	67	
22	SW. ¼	67	
23	S. ½	67	
24	N. ½ and SW. ¼	67	
26	N. ½	67	
27	All	67	
28	All	67	
31	All	67	
32	All	67	
33	All	67	
34	All	67	
35	N. ½	67	
3	NW. ¼	66	
4	N. ½ and SW. ¼	66	
5	All	66	
6	All	66	
7	All	66	
8	N. ½	66	
18	NW. ¼	66	
33	SW. ¼	67	
34	E ½ and SW. ¼	67	
35	SW. ¼	67	
36	SE. ¼	67	
1	All	66	
2	All	66	
3	S. ½	66	
4	NW. ¼	66	
5	NE. and SW. quarters	66	
8	All	66	
9	All	66	
10	All	66	
11	SE. ¼	66	
12	N. ½ and SW. ¼	66	
13	All	66	
14	NW. and SE. quarters	66	
15	S. ½ and NE. ¼	66	
16	N. ½	66	
17	All	66	
18	All	66	
20	SE. ¼	66	
21	All	66	
22	All	66	
23	W. ½ and NE. ¼	66	
24	NW. ¼	66	
26	All	66	
27	S. ½	66	
28	All	66	
29	N. ½ and SE. ¼	66	
30	S. ½ and NE. ¼	66	
31	NE. and SW. ¼	66	
33	E. ½	66	
34	N. ½ and SE. ¼	66	
35	All	66	
2	W. ½ and NE. ¼	65	
3	All	65	
7	SE. ¼	65	
8	NW. ¼	65	
9	All	65	
10	N. ½ and SW. ¼	65	

List of the mineral lands of Isle Royale—Continued.

m.	Part.	Township north.	Range west.
	NW. ¼	65	34
	All.	65	34
	All.	65	34
	N. ½ and SW. ¼	65	34
	NW. ¼	65	34
	S. ½ and NE. ¼	66	35
	S. ½	66	35
	All.	66	35
	N. ½ and SW. ¼	66	35
	NW. ¼ and SE. ¼	66	35
	NW. ¼	66	35
	All.	66	35
	All.	66	35
	SE. ¼	66	35
	E. ½ and SW. ¼	66	35
	N. ½	66	35
	E. ½ and SW. ¼	66	35
	SE. ¼	66	35
	E. ½ and SW. ¼	66	35
	All.	65	35
	All.	65	35
	All.	65	35
	E. ½ and SW. ¼	65	35
	N. ½	65	35
	E. ½ and SW. ¼	65	35
	S. ½ and NW. ¼	65	35
	All.	65	35
	All.	65	35
	S. ½ and NW. ¼	65	35
	S. ½ and NW. ¼	65	35
	N. ½ and SE. ¼	65	35
	N. ½	65	35
	NW. ¼	65	35
	All.	65	35
	NE. ¼ and SW. ¼	65	35
	All.	65	35
	NE. ¼	65	35
	NW. ¼	65	35
	SE. ¼	65	35
	N. ½	65	35
	S. ½ and NE. ¼	65	35
	All.	65	35
	S. ½	65	35
	S. ½ and NE. ¼	65	35
	All.	65	35
	All.	65	35
	N. ½ and SW. ¼	65	35
	S. ½	65	36
	S. ½	65	36
	All.	65	36
	All.	65	36
	N. ½ and SE. ¼	65	36
	All.	65	36
	NW. ¼ and SE. ¼	65	36
	NE. ¼	65	36
	N. ½ and SW. ¼	65	36
	SE. ¼	65	36
	All.	65	36
	All.	65	36
	S. ½ and NE. ¼	65	36
	All.	65	36

List of the mineral lands of Isle Royale—Continued.

Section.	Part.	Township north.
23	N. ½	65
24	NW. ¼	65
27	SE. ¼	65
28	NW ¼	65
29	NE. ¼ and SW. ¼	65
30	SE. ¼	65
31	N. ½ and SW. ¼	65
34	NW. ¼	65
35	S. ½	65
36	All	65
2	NW. ¼	64
3	N. ½ and SW. ¼	64
4	S. ½	64
7	SE. ¼	64
8	S. ½ and NE. ¼	64
9	NW. ¼	64
18	N. ½	64
23	SE. ¼	65
24	NE. ¼ and SW. ¼	65
25	N. ½	65
26	S. ½ and NW. ¼	65
27	NE. ¼ and SW. ¼	65
28	SE. ¼	65
31	SE. ¼	65
32	NE. ¼ and SW. ¼	65
33	S. ½ and NW. ¼	65
34	N. ½ and SW. ¼	65
36	SE. ¼	65
1	SW. ¼	64
4	S. ½	64
5	N ½	64
6	NW. ¼	64
8	SE. ¼	64
9	S. ½ and NE. ¼	64
10	N. ½	64
17	N. ½ and SW. ¼	64
18	S. ½ and NE ¼	64
19	N. ½ and SE. ¼	64
20	W. ½	64
1	All	64
2	SE. ¼	64
10	S. ½ and NE. ¼	64
11	N. ½	64
14	NW. ¼	64
15	NE. ¼ and SW. ¼	64
16	N. ½ and SE. ¼	64
17	S. ½	64
19	S. ½ and NE. ¼	64
20	All	64
21	NW. ¼ and SE. ¼	64
23	SE. ¼ and NW. ¼	64
24	S ½	64
25	S. ½ and NE. ¼	64
26	S. ½ and NE ¼	64
27	N. ½	64
28	S. ½ and NE ¼	64
30	S. ½ and NW. ¼	64
31	SE. ¼	64
32	N. ½ and SW. ¼	64
34	NE. ¼	64
35	NW. ¼	64

List of the mineral lands of Isle Royale—Continued.

Section.	Part.	Township north.	Range west.
6	NW. ¼	63	38
24	SE. ¼	64	39
25	S. ½ and NE. ¼	64	39
26	SE ¼	64	39
35	E. ½	64	39
36	All	64	39
1	N. ½	63	39
2	N. ½	63	39
9	SW. ¼	63	39
10	All	63	39
11	SW. ¼	63	39

List of the tracts containing iron in the region between Chocolate and Keweenaw bay, in the Lake Superior land district.

Section.	Part.	Township N.
33	SW. ¼	48
32	SW. ¼	48
19	SW. ¼	48
23	SE ¼	48
25	SE.	48
26	All	48
27	N. ½	48
28	NE. ¼	48
35	SE. ¼	48
8	S. ½	48
24	S. ½	48
23	SE. ¼	48
25	NE. ¼	48
7	SE. ¼	47
18	S. ½ of NE ¼	47
19	NW. ¼	47
22	SW. ¼	47
27	SW. ¼	47
28	S. ½	47
29	S. ½	47
30	SE ¼	47
31	N. ½	47
32	N. ½	47
33	N. ½	47
1	All	47
2	All	47
9	SE. ¼	47
10	All	47
11	NW. ¼ and SE. ¼	47
13	SW. ¼	47
14	NE. ¼	47
20	NE ¼	47
21	SE ¼	47
22	SW. ¼	47
24	W. ½	47
27	NW. ¼	47
28	NE. ¼	47
4	NW. ¼	47
1	SW. ¼	47
2	SE. ¼	47
5	NW. ¼	47
10	NE. ¼	47
11	N. ½	47
13	NE. ¼	47
2	NE. ¼	47
19	NW. ¼ and SE. ¼	47
30	SW. ¼	47
24	NE. ¼	47
25	SE. ¼	47
6	W. ½	46
7	All.	46
18	N. ½	46
1	All	46

logical map of Keweenaw Point, and list of the mineral lands.

COPPER HARBOR, *July* 23, 1849.

: We herewith transmit to you a geological map of Keweenaw included within the Lake Superior land district, on which the ter of each quarter section within the metalliferous range is in- l. Those tracts which are colored dark green, may be regarded eral lands—the remainder as agricultural.

electing those portions of the district which ought, in our opinion, egarded as "mineral lands," we have been governed by the fol- ; principles:

We have excluded from the list all lands which are not upon the nge, since the results of actual experience have clearly shown that ly in this formation that the veins have proved productive.

We have selected, within the trap range, those tracts upon which cks are exposed in such a manner as to render exploration for their l contents practicable; as where the subjacent rock is not covered ccumulations of drift, or the ground is not low and swampy, and ich either valuable veins have been already found, or which, by roximity to veins already proved, or by the general character of the posed, offer reasonable prospect of future profitable discoveries.

We have the honor to be your obedient servants,

J. W. FOSTER,
J. D. WHITNEY,
United States Geologists.

ON. THOMAS EWING,
Secretary of the Department of the Interior,
Washington, D. C.

List of the mineral lands of Keweenaw Point, Lake Superior.

Fractions.	Section.	Township.	R
SW. ¼	7	58	
	18	58	
W. ½	17	58	
N. ½	19	58	
NW. ¼	20	58	
	13	58	
	7	58	
	8	58	
	9	58	
	10	58	
	21	58	
S ½	4	58	
S. ½	5	58	
S. ½	6	58	
S. ½	11	58	
S. ½	12	58	
N. ½ of SE. ¼	14	58	
N. ½	24	58	
NE. ¼	15	58	
S. ½	17	58	
S. ½	16	58	
SE. ¼	18	58	
NE ¼	19	58	
N. ½ and SE. ¼	20	58	
N. ½	28	58	
W. ½	22	58	
NW ¼	27	58	
	7	58	
	8	58	
	9	58	
	11	58	
	12	58	
	26	58	
	27	58	
	28	58	
	29	58	
	30	58	
	23	58	
S. ½	1	58	
S. ½	2	58	
N. ½	13	58	
N. ½	14	58	
N. ½	15	58	
N. ½	16	58	
N. ½	17	58	
N. ½	18	58	
N. ½	24	58	
N. ½	25	58	
N. ½	31	58	
N. ½	32	58	
S. ½	19	58	
S ½	20	58	
S. ½	21	58	
S. ½	22	58	
S ½	10	58	
	8	58	
	9	58	
	10	58	
	11	58	
	12	58	
	15	58	

List of mineral lands of Keweenaw Point —Continued.

Fractions.	Section.	Township.	Range west.
	16	58	30
	17	58	30
	18	58	30
	25	58	30
	31	58	30
	32	58	30
	33	58	30
	34	58	30
.....	6	58	30
.....	35	58	30
.....	36	58	30
.....	26	58	30
.....	27	58	30
.....	28	58	30
.....	29	58	30
SW. ¼	7	58	30
.....	13	58	30
.....	14	58	30
.....	19	58	30
.....	20	58	30
	13	58	31
	14	58	31
	20	58	31
	21	58	31
	22	58	31
	23	58	31
	24	58	31
	30	58	31
.....	12	58	31
.....	15	58	31
NE. ¼	19	58	31
NE. ¼	29	58	31
.....	11	58	31
.....	28	58	31
.....	31	58	31
.....	36	58	31
	36	58	32
NE. ¼	35	58	32
NE. ¼	25	58	32
	6	57	30
SW. ¼	5	57	30
.....	4	57	30
SW. ¼	1	57	31
SW. ¼	2	57	31
.....	3	57	31
.....	4	57	31
.....	11	57	31
.....	10	57	31
.....	9	57	31
.....	8	57	31
	2	57	32
.....	1	57	32
NE. ¼	3	57	32
	10	57	32
.....	11	57	32
.....	15	57	32
.....	16	57	32
	21	57	32
.....	22	57	32
.....	29	57	32
NW. ¼	28	57	32
	27	57	32

List of mineral lands of Keweenaw Point—Continue

Fractions.	Section.	Township
E. ½ and SW. ¼	31	57
N. ½	32	57
E ½ and SW. ¼	33	57
W. ½ and NE. ¼	34	57
W. ½	26	57
S. ½ and NE. ¼	35	57
SW. ¼	36	57
W. ½	4	56
S. ½ and NW. ¼	5	56
E. ½	6	56
N. ½ and SE. ¼	7	56
N. ½ and SW. ¼	8	56
W ½	17	56
E. ½	18	56
	19	56
W. ½	20	56
W. ½	30	56
W. ½	2	56
SE. ¼	3	56
SW. ¼ and NE. ¼	10	56
N. ½	11	56
SE ¼	25	56
SE. ¼	35	56
	36	56
NW. ¼	1	55
S. ½ and NE. ¼	2	55
SE. ¼	3	55
NW ¼	11	55
S. ½ and NE ¼	10	55
NW. ¼	15	55
	16	55
S. ½ and NE. ¼	20	55
NW. ½	29	55
N. ½	30	55
N ½ and SW. ¼	24	55
SE. ¼	23	55
N. ½ and SW. ¼	25	55
	26	55
SE. ¼	27	55
SE ¼	35	55
S ½	36	55
W. ½	16	54
	17	54
SE. ¼	18	54
NW. ¼	19	54
E. ½	23	54
W. ½ and SE. ¼	24	54
W. ½	25	54
E. ½	26	54
NW. ¼	36	54

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Geological map of the country between Portage lake and Montreal river.

BRUNFIELD, MASS., *November* 12, 1849.

SIR: We herewith transmit a geological map of the iron region in the Lake Superior land district. The mineral tracts are indicated by a symbol, thus (♂). Our synopsis was sent last week: please acknowledge the receipt of both.

With great respect, your obedient servants,

J. W. FOSTER and
J. D. WHITNEY,
Geologists.

By J. W. F.

Hon. JUSTIN BUTTERFIELD,
Comm'r of the Gen. Land Office, Washington.

COPPER HARBOR, *July* 25, 1849.

SIR: We herewith transmit to you a geological map of the country lying between Portage lake and the Montreal river, on which all of the tracts which are regarded by us as "mineral" are indicated by quarter sections. The same principles have governed us in the selection of these tracts as governed us in the selection of those of Keweenaw point. These two maps embrace all of the mineral lands on the southern shore of Lake Superior, within our district. In the course of a month, or six weeks, we will transmit a geological map of Isle Royale, constructed on similar principles, which will complete the geology of all the "copper region."

In our report of next winter, we will endeavor to afford all the information respecting these lands required by the act of March 1, 1847, authorizing the survey.

With great respect, your obedient servants,

J. W. FOSTER and
J. D. WHITNEY,
U. S. Geologists for the Lake Superior district.

Hon. THOMAS EWING,
Secr'y of the Departm't of the Interior, Washington, D. C.

List of mineral lands between Portage lake and the Montreal river, Lake Superior land district.

[The mineral lands in township 54 N. have been reported.]

Fractions.	Section.	Township.	Range west.
SE. ¼	25	52	37
	36	52	37
E. ½ and SW. ¼	35	52	37
NW. ¼	1	51	37
N. ½ and SW. ¼	2	51	37
W. ½	11	51	37
S ½ and NE. ¼	10	51	37
N. ½ and SW. ¼	15	51	37
S. ½	16	51	37
NW. ¼	22	51	37
	21	51	37
SW. ¼	29	51	37
S. ½	30	51	37
NW. ¼	32	51	37
N. ½	31	51	37
NW. and SE. quarters	25	51	38
N. ½	26	51	38
N. ½ and SW. ¼	36	51	38
	35	51	38
SE. ¼	1	50	39
N. ½ and SW. ¼	12	50	39
S. ½	11	50	39
S. ½	10	50	29
NW. ¼	13	50	39
N. ½ and SW. ¼	14	50	39
	15	50	39
E. ½	16	50	39
NW. ¼	22	50	39
NE. ¼	21	50	39
SW. ¼	30	50	39
NW. ¼	32	50	39
N. ½	31	50	39
S. ½	25	50	40
	36	50	40
N ½	35	50	40
S. ½	34	50	40
S. ½	33	50	40
N. ½	4	49	40
	5	49	40
	6	49	40
N. ½	7	49	40
S ½ and NE. ¼	1	49	41
S. ½	2	49	41
SE. ¼	3	49	41
N. ½	12	49	41
N. ½	11	49	41
NE. ¼	10	49	41

eld-notes made by George O. Barnes, assistant sub-agent—notes made while associated with J. D. Whitney on the Ontonagon district.

Tuesday, July 6, 1847.—I left Copper Harbor at 3 p. m., in our boat, r the Ontonagon river, in company with Messrs. Whitney, Bernard, mith, and two Indians. We had a fine easterly wind for most of the ay to Eagle Harbor, at which place we arrived at 8 p. m., and remained ere all night.

Wednesday, July 7.—We left Eagle Harbor at 8 p. m., rowing to Eagle ver, where we stopped for a short time, and then proceeded to a spot e named Cedar Grove, 4 miles west of the Portage, and camped.

Thursday, July 8.—Left Cedar Grove at 7 a. m., and coasted to Elm ver, where we dined. We camped to-day on a sand-beach 5 miles east the Ontonagon river. We passed a long extent of high bluffs of sand-one, varying from 10 to 100 feet in height. There are numerous caverns these bluffs, which were excavated by the lake waters.

Friday, July 9.—We arrived at the mouth of Ontonagon river at 8½ p. . It is six rods wide at the mouth, with about 7 feet of water on a bar, hich shifts its position with every storm. There are about 20 buildings ear the mouth of this river, used as dwellings and storehouses for the ifferent copper companies on the river. We left at 2 p. m. for the ra-ids, which are 12 miles distant by the river, which bends and winds out to such a degree that there are not two miles in a direct line for the hole twelve miles. The soil on the banks of the river is clay and loam, ery suitable for agricultural purposes. The timber is maple, elm, linden, nd pine, which are of luxuriant growth, and indicate favorably for the uality of the soil. The river, which, for 8 miles up, has but a gentle rrent, is wide and sufficiently deep for small vessels to navigate till we ome to the first rapids, when the water is shallow and flows at the rate f four miles an hour, making it difficult for even small boats to ascend. wo miles above the rapids are the warehouses of the Ontonagon Cop-er Company; at which place we arrived at 7 p. m., and camped.

Sunday, July 11.—Left camp at rapids in company with Messrs. Whit-ey and Bernard to visit the Ontonagon Company's works, No. 602, hich are six miles southwest from the rapids; their agent, Mr. Cush-an, showed us the drifts, of which they have two—one at the base of e hill, the other near the top, which is 30 feet long; that at the base, 60 et. They have no well defined vein, but a mass of epidote containing ative copper, in thin sheets and fine particles, scattered through the rock. he richest of this mass is 12 feet wide, and has a course S. 76° W. rough the hill. Returned at rapids.

Monday, July 12.—Remained in camp at rapids. Two of Judge Burt's ackmen arrived to-day for provisions to take to the parties south, in the oods, who are expected in to this point soon, when one of us will re-rn with them.

Tuesday, July 13.—Mr. Burt's packers had our boat and men to go to e mouth of the river for provisions, and take them to the Baltimore ompany's location, which is 12 miles above our camp, on the west anch of the river, where they expect to meet their party.

Wednesday, July 14.—Remained in camp with Messrs. Whitney and mith. Boat and men are at the mouth of the river. Mr. Bernard went uth of the correction line one mile on a line to meet Mr. Burt.

Thursday, 15*th*.—Went with Messrs. Whitney and Smith to Cushman's, Ontonagon Company's location, No. 602, at which place we arrived at 10 a. m. We took the course of the vein, and examined the bluffs near the river. Had dinner, and started for the place where the copper rock was found, but were obliged to return by the sudden approach of a thunder storm. We arrived at the cabin completely drenched with rain. It rained all the afternoon and evening, detaining us at Cushman's for the night.

Friday, *July* 16.—Rainy all the morning, but about 2 p. m. clearing up. We left at 3 for United States Company's location, No. 54, at which place we arrived by 4 o'clock. Examined their drifts, which they have driven 15 feet on an east and west vein of epidote and quartz, carrying finely divided particles of native copper. They have worked but little on their location, and the vein has been but partially explored, and no opinion can be formed of its value. The course of the vein is nearly east and west, dipping into the bluffs at an angle of 43° to the northward; the agent of this company is expecting miners from below, and hopes soon to be able to explore and prove the veins more satisfactorily. We stopped at this company's cabin to dinner, and then proceeded on to the American Exploring Company's cabins, which are two miles west of the Ohio Trap Rock Company, on the same range of cliffs. The veins belonging to this company resemble the Ohio Company's in composition. They have not, as yet, done any mining, and have left but two men to keep the location. The copper in the vein is very much oxidized on the surface, and has been mistaken for a vein of red oxide of copper. We left this location, and arrived at our camp at 7½ p. m.

Sunday, 18*th*.—Remained in camp at the rapids.

Monday, *July* 19.—Went with Mr. Smith to a small lake we had had described to us as being three quarters of a mile down the river, a few rods west of the banks. The men returned with boat to-day, bringing letters from on board the Julia Palmer, which arrived at the mouth of the Ontonagon river yesterday.

Mr. Whitney received one from Dr. Jackson, who is on board the steamboat on his way to Isle Royale.

Tuesday, *July* 20.—Remained in camp at the rapids, waiting for Judge Burt to arrive. Two of his men and horses arrived here this afternoon by way of Cushman's road.

Wednesday, 21*st*.—Remained in company yesterday. Judge Burt arrived here at 9 a. m., and went to the mouth of river with our boat and Indians. Mr. Bernard accompanied him. They returned at 8 in the evening.

Thursday, *July* 22.—In camp at Grand rapids. Mr. Austin Burt and company arrived here, and proceeded directly to Cushman's. John Burt and company arrived in the afternoon, and camped near us for the night.

Friday, *July* 23.—Went with Messrs. Burt to Cushman's location, where we dined. At 2 p. m. we started for United States Company. I left the party on the road and proceeded to the United States Company's, and there met Judge Burt, and went with him to American Exploring Company's cabins, where we remained during the night. Mr. Burt's men encamped near the line. They are to go south, nearly three-quarters of a mile east from cabin.

Saturday, *July* 24.—Had breakfast at Davis's, and started with Judge Burt for the camp of his men, at which point we arrived at 6 a. m. I started south at 7½ with the whole of Messrs. Burt's parties on the range

ines between T. 40 and 41. We forded the west branch of the Ontonagon river, after travelling one mile south. The land near the river is low and swampy; for three miles back it is rolling ground, with maple, hemlock, pine, and oak timber, and is good farming land; soil red, clayey loam. Four and one-third miles south from point of starting, we stopped for dinner. It commenced raining, and we could not proceed farther, and were obliged to camp.

Sunday, July 25.—In camp on line 12 miles south of correction. Rainy all day.

Monday, July 26.—Started south from camp on line at 6 p. m., near the southeast corner of range 41, township 47. Forded small stream with banks of red clay and loam; timber, maple, hemlock, cedar, and spruce; camped at evening, making 12 miles travel to-day. Went through three cedar swamps. The greater part of this day's travelling was over low and nearly level ground. At 10 miles from camp I came on to rolling land with good growth of maple. This growth continues to swamp, 24 miles south of the correction line.

Tuesday, July 27.—Started south at 6 a. m. on line; went over good agricultural land for three miles, with occasional cedar swamps, section 24. township 46, range 40. Saw a small ledge of chlorite slate, with a vein, 6 inches wide, of red felspar, (specimens Nos. 1 and 2.) We had our dinner at the corner near lake, township 46, range 40. Up to this time the three parties engaged on this contract worked together, while I have been with them; they were backing down to commence work up again. At this corner Mr. Austin Burt left, to run west 18 miles, and proceeded south, crossing the lake on a raft.

Wednesday, 28th.—Went south to town corner, where Wells Burt is to run west, and camped on account of rain. I went with two of the men to a small lake, about one-fourth of a mile south of our camp, and caught several black bass.

Thursday, 29th.—In camp at corner, near a small lake, 36 miles south of correction line. Went to the lake and fished, the day being cloudy, so that we could not run the line with the solar compass.

Friday, 30th.—Cloudy until 10 a. m., when Wells Burt started with the line. I remained in the old camp with Mr. John Burt and company, until 1 p. m., when we proceeded west on Wells's line, overtaking him 3 miles from the corner. Went on half a mile west to the lake, which we walked around. Intersected the lake, and crossed the outlet on our way around. Crossed near a sheet of water, which I called Gooseberry lake. There is excellent farming land on the west side of this lake, and near where we camped there is a ridge covered with sugar maples, formerly an Indian sugar grove.

Saturday, 31st.—In camp at Gooseberry lake. Mr. Burt sent two men across the township north to meet Austin Burt's party for provisions, ours being nearly exhausted.

Sunday, August 1.—In camp at Gooseberry lake. Left at 5 a. m. for Wells Burt's camp, one mile west of the lake, where we had dinner. Wells Burt started south for the boundary line, and we went on four miles west of the corner, and camped. Crossed two small lakes on the line. Saw no rock, but swampy land prevails all the way.

Monday, August 2.—Left camp at 5½ a. m., and went west to the corner of section 45, range 42, and dined there. Ran north with the line

at 1 p. m.; went three miles north from township-corner, and camped. No rocks seen in place.

Tuesday, August 3.—Left camp at 6 a. m., to run north with the line. Crossed, after one and a half mile's travel, a river running northwest, and went on to the corner, and camped one-half mile from north corner, and found rocks (see specimens Nos. 4 and 5) which are similar to those at section 24, township 46, range 40. Austin Burt, whom we met at the corner, gave me some specimens of mica slate and hornblende slate, which he found in section 35, township 46, part, range 41 west.

Wednesday, August 4.—In camp all day at township-corner. Could not run for want of sunshine. Austin Burt and party are camped near this place.

Thursday, August 5.—I left camp with John Burt to go north. At 8 a. m., one mile north of corner, I saw a ledge of red granite; its course was northeast, and I traced it twenty rods. Travelled four miles to-day, and camped at the section-corner.

Friday, August 6.—Left camp at section-corner at 8 a. m., to go north on the line. One mile south of township-corner, saw ridges of greenstone and granite. Remained at corner and dined, waiting for John Burt to come through west with his line. Started west at 1 p. m., with Mr. John Burt's compass man, while he went south to correct the line we had just run. A quarter of a mile west from the corner, we found specimens of sienitic granite, the direction of the bed being northeast. A few rods further on, saw a ledge of greenstone. A mile and a half north of the corner, saw ridges of coarse granite from 30 to 40 feet high. A short distance from these ridges, saw greenstone and granite ridges 30 feet high. Two miles west of the corner, camped. The line to-day has been over numerous knobs or ridges of granite and greenstone, rising abruptly from the low ground on one side, and descending rapidly on the other.

Saturday, August 7.—Left camp at 7 a. m., to go west with the line. Three miles west of township-corner, saw a ridge of granite about 30 feet high, running northeast. Dined at section-corner three miles west. A quarter of a mile west of section-corner, I saw granite. Half a mile from section corner, we crossed a river, and camped near a good meadow.

Sunday, August 8.—Left camp at the meadow at 8 a. m., to go west. A quarter of a mile west of our camp, I saw a ledge of granite 150 feet high, and saw also several ledges of granite like those observed yesterday. They are small knobs, rather than ranges of continuous rocks. At township-corner, I saw greenstone rocks. Camped at this corner, to wait here for Austin Burt to come north.

August 9.—Austin Burt came to our camp at 12 m., took dinner, and went north with the line. Half a mile north of township-corner, saw ledges of greenstone. Two miles from township-corner, saw a ledge of greenstone. Two miles from this corner, the variation ranged from $3\frac{1}{2}°$ to $7\frac{1}{2}°$ in less than one-eighth mile, which Mr. Burt thinks indicates trap rocks: saw none in place, however. Two and a half miles north from corner, saw greenstone. Camped this night three and a quarter miles north of the corner, at the margin of a swamp.

Tuesday, August 10.—Left camp at 6 a. m. to go north. Four miles north of corner, saw a range of porphyritic trap. Half a mile further, crossed a river running northwest: it is four rods wide. Went on to township-corner and camped, waiting for John Burt's party to come in west of us.

Friday, August 11.—Went east, on line with John Burt's men, at 6 a. m. Went through to east corner, and started north with their men, who are to measure the line that John ran yesterday. Went one mile and a half north; had dinner, and went on one mile and intersected Lake Agogebic. Made a raft and went across the lake. When we had proceeded about a mile, a violent thunder storm obliged us to go on shore. Camped on shore of the lake, and there saw large blocks of coarse gray sandstone on the westerly shore of the lake.

Sunday, August 12.—Left camp at shore of lake on a raft to go across it at 7 a. m., and arrived on the north shore at 10, and there met John Burt. Travelled north to the corner, which is near the Charter Oak Company's cabins, and dined. The corner is on trap rock two-thirds of a mile north of the lake. There is but one man residing here, who is left to keep the location. At this place the trap rock is highly epidotic, and contains a small quantity of native copper. The company have explored and blasted in several places, but have not as yet found a regular vein. I took specimens of the epidote, which contains a small quantity of native copper. The cabin is half a mile north of Lake Agogebic. Camped at the corner, and remained in camp for Judge Burt to come through west and close to our course. Then I went west on the line. We travelled over high ridges of trap, the course of which seemed to be about northeast and southwest. Two miles and a half west of the corner, I saw a ledge of porphyritic trap, (specimen No. 7.) Travelled three miles and three-quarters to-day and camped. The timber seen is mostly maple and hemlock, growing on a good soil.

Sunday, August 15.—Left camp to run west with line. At 7¼ a. m., went over good maple-timbered land to corner; at which we arrived by 4 p. m., and found Mr. Austin Burt encamped. I remained in his camp. The men came west with the line, and returned east to the corner. Mr. Austin Burt furnished me with specimens of trap which he saw in place on section 12, of township 48, range 44: the course of the ledge was northeast. We travelled two and a half miles this day.

Monday, August 16.—In camp with Austin Burt; rainy, which detained us here two days, 16th and 17th.

Wednesday, 18th.—Left camp at the corner at 6 a. m., in company with Mr. Austin Burt and party, to run north six mines to corner, and went on three miles over rolling land, with maple and birch timber, and stopped for dinner at this place. Our Indian *voyageur* cut his foot, and I was obliged to leave him in charge of one of Mr. Burt's men, whom Mr. Burt kindly allowed to remain. I built him a bark wigwam, and then camped with him till the next day. I saw no rock in place this day, but should think there must be trap rocks.

Thursday, 19th.—I left the Indian's camp with Burt's men, to go to the corner of township, on my way to Iron river. Arrived at the corner 9 a. m., where we remained to meet Mr. John Burt's compass-man, who was to run through west and intersect our line, and establish a township-corner. Mr. Burt's man did not arrive till 5 p. m., which made it too late to return to-night. We were, therefore, obliged to encamp here. The three miles travel to-day has been over good rolling land, with a heavy growth of maple, birch, and hemlock. I saw no rocks in place.

Friday.—Left camp at corner at 6 a. m., to go east on the line with Mr.

John Burt's compass-man. We went through several swamps and a tangled growth of poplar. The whole six miles is through very hilly and swampy country, but no rocks were seen. Arrived at the corner at 11 a. m., and took our dinner. I went a short distance south, and intersected the trail from Agogebic lake, to the mouth of Iron river, and followed it to the end, and arrived at Iron river at 6 p. m., where I saw Messrs. Whitney, Bernard, and the Indian. Camped with them at this place, having travelled twenty-two miles to-day.

Saturday.—In camp at mouth of Iron river. Mr. Bernard and our other Indian started this morning to take provisions to the wounded Indian I had left in the woods. Judge Burt's man arrived here to-day, and encamped near by us.

Sunday.—In camp at Iron river, where there are three or four houses, built of logs. Only one white American family resides here at present. A large number of Indians live in wigwams, and are now on their return home from the payment. There are, perhaps, two hundred souls, men, women, and children. It has been urged by some of the agents for copper companies in the vicinity, that this town should be named *Pewabic*—the Indian name for iron; and it is generally adopted here. Mr. Bernard returned to-day with the Frenchman I had left with the wounded Indian, leaving our other Indian to take care of him.

Monday.—Left Pewabic at 10 a. m., in company with Messrs. Whitney and Bernard, to visit Union River Company's works; we each of us took a pack of provisions, and walked along the coast to the trail up to the mines, where we arrived at 11½ a. m, and camped near the shafts of the mine. In the afternoon Mr. Whitney went to examine the bed of Union river. I remained in camp. Mr. Smith, our packman, whom we sent to Copper Harbor for provisions, arrived to-day, having been detained by head winds for two weeks.

Tuesday, August 24.—I left camp at Union river with Messrs. Whitney and Bernard to examine a location known by the title of Tom Palmer's, leaving our camp in charge of Mr. Smith. We set out at 7 a. m., and arrived at the mine at 10 The men on this location have sunk a shaft in the very hardest kind of sandstone, to the depth of 20 feet, and have found only a seam of clay about two inches wide, without an atom of copper, so far as I could see. The shaft is a nice one, being about 10 feet square. This mine is near the correction line, which we intersected and followed to the township corner, and is in trap rock. Went north on township line two miles, then three miles east by the section line to camp, where we arrived at 6 p. m., and remained for the night.

Wednesday.—Left Union river at 7½ a. m. with Mr. Bernard, and I went on section line to Carp river, examining the bed of this stream for two or three miles. Saw the junction of trap and sandstone with breccia near where the section line crosses the river; proceeded south one mile from the river, then east to Tom Palmer's, thence to camp; at which place we arrived at 6 p. m. Determined the junction of the sandstone in numerous places, of which Mr. Bernard took the notes and made a sketch of the river. On Iron river I saw nothing but sandstone and conglomerate rocks.

Wednesday.—Iron river camp at Isle Royale Company's landing. Detained by strong head winds in the morning. Went to the mine, distant about three miles from the landing. They have a vein of native copper

ipping into the hills at an angle of 45° N. The copper here is coated ore or less with red oxide on the surface. They have sunk two shafts the vein, with but little success. We followed the face of the cliff for alf a mile east, then went north to strike the trail to the lake. At 3 p. . left camp and rowed to Carp river, at which place we arrived at 1 p. ., and camped.

Thursday.—Left camp at Carp river in a boat for Presq'isle river, at hich place we arrived at 8 a. m., and camped on account of the rain. here are two log cabins at this place, with two men to retain the location the mouth of the river, where there is a fine fall of water of sufficient wer for three saw-mills.

Friday, September.—Left mouth of Presq'isle river to visit location No. 9, with all our party. The distance is about 7 miles up the river by e trail. They have not commenced mining here, and have but one an on the location. We saw several small veins of calc spar and ehnite in the amygdaloid rock, but no good vein of copper.

Saturday, September.—I went up the river two miles to explore, and w veins of calc spar, with but little copper; and porphyritic trap occurs out a mile above the cabins, in the river. Returned to camp at 1 p. m. essrs. Whitney and Bernard explored down the stream and determined e junction of the trap and sandstone.

Sunday.—Remined in camp at location 149.

Thursday.—Day rainy. Went in the afternoon to Union Company's ine; they are working a seam of red clay which contains native copper small quantities, and is near the junction of sandstone and trap. At e underside of this seam of clay come in strata of chlorite or talc, with pper. The dip is about 40° to northward. They have sunk two shafts the vein with but little success, obtaining, however, from one of the afts (the most westerly one,) some fine specimens of crystallized copper. ook specimens of ore and then proceeded on to Iron river with Mr. Ber- rd. At Iron river we took a pack of provisions and started for our ounded Indian and travelled to the correction line, and then camped open air for the night.

Friday, August.—Proceeded on to the wounded Indian, arriving at his mp at 6 p m. and stopped for the night.

Saturday.—Left Indian's camp at 6 a. m., taking with us the Indian ft in charge, to carry more provisions back for him. Arrived at Pewabic 6 p. m , making 22 miles travel to-day.

Sunday.—Remained in camp at Iron river; sent Indian back with pro- sions.

Monday, August —In camp at Pewabic all day, strong NW. wind.

Tuesday.— Left camp at Pewabic in boat with Messrs. Whitney, Ber- rd and Smith for Presq'isle river. Put in to the landing place of the Isle oyale Company, a distance of about 8 miles from Iron river, and camped. ould not proceed on account of the strong NW. wind, which is ahead for s on this shore.

Monday, September.—Left our camp for the mouth of Presq'isle river, here we arrived at 10 a. m., and remained for the day, as it rained, and e wind blew so fresh we could not proceed; we therefore camped in the arehouse.

Monday, September.—Remained at Presq'isle river all day; wind strong om NW.

Tuesday, September.—Left the mouth of Presq'isle river at 10 a. m. for a location about 9 miles SE. from mouth of river, and owned by the Charter Oak Company. At this place we arrived at 5 p. m., and remained for the night.

Wednesday.—Examined workings for copper on this location. They have a small vein of prehnite, with small particles of native copper interspersed, but not a flattering prospect for mining operations.

Thursday, September.—Left Charter Oak Company's cabin by trail to Agogebic lake; saw but little trap rock in place; camped about 6 miles west from Agogebic lake.

Friday.—Went on by trail to Charter Oak Company's cabins, near Agogebic lake, and camped at 4½ p. m.; examined the bluff for copper veins, but saw none.

Saturday.—At Charter Oak Company's cabin all day. Messrs. Whitney and Bernard went east on a range of trap to explore.

Sunday, September 12.—I left Charter Oak Company's cabin at 7 a. m., and took the trail to mouth of Iron river, in search of letters at the office; arrived at Iron river at 2 p. m., making 20 miles travel to-day; found our lame Indian and his nurse encamped at the lake.

Monday, September 13.—In camp at Pewabic waiting for some conveyance up the lake to Presq'isle river, where I expect to meet Mr. Whitney, who returned through the woods and remained here all day.

Tuesday, September 14.—I left with our two Indians in a boat for Presq'isle river at 8 a. m., arriving there at 3 p. m., where I met the remainder of the party, as expected; camped at the old camp ground at the mouth of river, and left the lame Indian there.

Wednesday, September 15.—We left Presq'isle river in our boat for Montreal river, and went on to a place called Dead-man's river, when the wind obliged us to land and camp for the night.

Thursday, September 16, 1847.—Left Dead-man's cove at 8 a. m., and rowed to Montreal river, where we encamped at 12 m.; went in the afternoon to examine the falls, which are truly beautiful. The water falls some 80 or 90 feet in two cascades over conglomerate rocks, and can be seen a long distance from the lake.

Friday, September 17.—Left the mouth of Montreal river with Messrs. Whitney, Bernard, Smith, and one Indian, taking the trail of the river to location No. 19, where we arrived at 10½ a. m., and occupied the cabins built by the company, which are now abandoned. This company's mine is at the second falls, about three miles in a direct line from Lake Superior. The falls here are as beautiful as those before mentioned, being of about the same height, and falling over sandstone rocks.

Saturday, 18th.—Went with Messrs. Whitney and Bernard to the bed of the river, to measure the width of sandstone belts, of which there are six in the space of half a mile. Beginning at the trap, we went down the river about 3¼ miles from the cabins, and saw the junction of trap, conglomerate, and sandstone. It is about 3 miles S. from the lake that trap occurs, the shores being composed of conglomerate and sandstone rocks.

Sunday, September 19.—Remained in cabin on location No. 19. Mr. Whitney made sketch of falls.

Monday, September 20.—Went with Mr. Bernard to examine a mine, and saw several veins of quartz, on which the company have drifted, and found but little copper. Proceeded down the river to the junction of the

nd sandstone. The banks of the river here are nearly 200 feet high;)ered up the bank, and then went back to the cabin.
tesday, 21*st*.—Left location No. 19 at 8 a. m. for Lake Superior, e we arrived at 10 a. m. Took our boat and sailed with a fair wind ack river, where we arrived at 5 p. m., and camped at mouth of the

ednesday.—Left camp at the mouth of the river to visit location No. 8 a. m., and arrived at 11, and camped near the cabin. But one his wife and daughter, remain on the location, and to them we are ted for much hospitality. In the afternoon we went to a high hill, Mount Morell, the summit of which is jasper and the base trap. ompany have drifted on a vein of prehnite at this place, and have found ttle copper. Returned to our camp.
ursday.—Left location 26; went W. two miles; intersected the range and followed it 8½ miles south, and camped. Low and swampy land s most of this distance.
iday.—Remained in camp at the swamp 2½ miles south of T. corner.
turday.—Remained in same camp all day.
nday, 26*th*.—Left camp at 8 a. m. to go east on line, and went six and camped. We have seen to-day numerous knobs of granite ; abruptly from swamp below. In the afternoon, Mr. Whitney ex- ed north of the camp. Mr. Bernard and myself went south two , and saw nothing but knobs of granite. Returned to camp at 5

nday, *September* 27 —Left camp to go north to Presq'isle river, and 11 miles and camped.
tesday, *September* 28.—Left corner at 8 a. m. with Mr. Bernard to est to No. 26, where we arrived at 11 a. m. The distance is five . In the afternoon went with Mr. Alexander, the agent in charge, amine their veins, which are in the river's bed, but saw nothing ising to be a profitable mine. Remained at this place for the night. Whitney returned directly north to Lake Superior, to the mouth of 'isle river.
ednesday.—Left Alexander's at 8 a. m., for Black river, where we our boat and rowed to Presq'isle, and found Mr. Whitney waiting . Remained till 3 p. m., when we put off for the Ontonagon river, g with us our lame Indian. A 5 p. m. we arrived at Carp river, and ed for the night.
ursday.—Left our camp at Carp river, for the Atlas Company's loca- Mr. Jones agent. Arrived there at 12, took dinner, and went in fternoon to examine the mine. The company is working a spar and ite vein, but little copper is found in it. Went down the river to andstone, and followed the township line to camp.
iday, *October* 1.—Left Carp river at 8 a. m., in a boat, for Iron ; which place we left at 4 p. m., for the Ontonagon, and went five , and camped on a sand beach.
turday, *October* 2.—Left our camp, on the beach, for the Ontona- river, and proceeded to the Grand rapids, and camped at Musquito

nday.—Left Grand rapids at 8 a. m. for Cushman's location, No. went to look at the mine. The company has done but little mining we left, but have built a furnace and a saw-mill.

Monday.—Left camp and went to Copper Rock Company's location, and saw the place where copper was found. On our way back visited Cushman's saw-mill and furnace, which are not in operation.

Tuesday.—Left camp at Cushman's, on the Ontonagon, for the mouth of the river, and arrived at 10 at Musquito Hall, where we had left our boat. From thence we went down the river to the lake shore, and camped for the night.

Wednesday.—We remained all day at the mouth of Ontonagon river.

Thursday.—Left the Ontonagon at 8 a. m. for Copper Harbor, and went three miles east of Elm river, and camped.

Friday.—Left camp at lake shore, and went to Salmon Trout river, where we were obliged to put in, owing to head winds.

Saturday, October 19.—Left camp at 7 a. m ; rowed, against a strong sea, for a sand beach one mile east of the Portage, and camped. Remained till Thursday, when we went to a spot eight miles west of Eagle river, and camped.

Friday.—Left for Eagle Harbor at a. m., and remained there for the night.

Saturday.—Arrived at Copper Harbor at noon.

GEORGE ORVILLE BARNES.

Analysis of black oxide of copper from Copper Harbor.

A very pure specimen was dissolved in chlorohydric acid. The small quantity of silica which was intermixed with it, as silicate of copper, was separated, and was found to be equal to 1.2 per cent. The remainder was pure black oxide of copper, with a hardly weighable trace of iron.

Another specimen gave 1.7 per cent. of silica.

A portion of the purest specimen which could be obtained was ignited gently, to drive off water, and reduced by hydrogen in a bulb-tub. The loss of weight (oxygen) was = 19.91 per cent., which corresponds to 98.6 per cent. of oxide of copper.

This may, then, be regarded as almost chemically pure black oxide of copper. The composition would therefore be—

Copper 79.86
Oxygen 20.13

For analyses of *jacksonite, chlorastrolite, wollastonite, pectolite, coracite*, see Boston Journal of Natural History.

Datholite from Isle Royale.

Determination of water on small fragments: 2.287 grammes lost on ignition .091 = 4.00 per cent.

1.4148 grammes, attacked by hydrochloric acid, almost entirely dissolved without gelatinizing. On being evaporated it gelatinized, however, and was separated by evaporation in the usual way.

Silica - - -	0.5325 =	37.64 per cent.
Lime - - -		33.30
Boracic acid (by loss.)		

The mineral, which was a massive granular substance of a greasy touch, being evidently datholite, the analysis was not finished, the methods of

determination of the boracic acid being too incomplete to make it worth while to determine it in the case directly.

Examination of green radiated soft mineral in the rock, (supposed to be identical with chlorastrolite, but softer.)

Determination of water: .6785 grammes lost .0355 by ignition = 5.23 per cent.

The mineral could not be entirely freed from the epidote; so the analysis is only an approximation.

Silica - - - -	42.6
$\dddot{Al}$ and $\dddot{Fe}$ - - -	31.2
$\dot{Ca}$ - - - -	20.6
‡ - - - -	5.23
	99.63

Analysis of red felspar from the Copper Falls mine.

This singular variety of felspar, which occurs at several places on Lake Superior, has been mistaken for stilbite, on account of its close resemblance to that mineral in its general habits. Of course, it would easily be seen from its lustre and hardness, on a closer inspection, that it could not be that mineral; it was then presumed to be new. It forms imperfectly radiated, fasciculated masses, indistinctly crystallized, of a flesh-red color, forming delicate crystallizations on the trap.

0.987 gramme fused with carbonate of soda, gave—

0.647 $\ddot{Si}$ = 65.88 per cent.

$\ddot{Al}$ and $\ddot{Fe}$ .176 = 17.92

containing $\ddot{Fe}$ .57

leaving 17.35 per cent. $\ddot{Al}$.

Results:

Silica - - -	65.88
Alumina - - -	17.35
Oxide of iron - -	.57

(Potash and soda by loss.)

The mineral is evidently felspar.

Analysis of leonhardite by Mr. Barnes, made under my direction.

	‡	¤
Silica - - -	55.96	55.04
Alumina - -	21.04	22.34
Lime - - -	10.49	10.64
Water - - -	11.93	11.93
	99.42	99.95

The formula of leonhardite—3 $\dot{C}a\,\ddot{S}i + 4\,\ddot{A}l\,\ddot{S}i^2 + 15\,\dot{\boxplus}$—requ

Silica - - -	56.57
Alumina - - -	21.99
Lime - - -	9.40
Water - . -	12.02

BAROMETRICAL OBSERVATIONS AND TABLE OF HEIGHTS.

AT MOUTH OF FIRE-STEEL RIVER.

Date.	Hour.	Barometer.	Thermometer—Cent.	Temperature—Fahr.	Remarks.
1848.					
Sept. 13	9 a. m.	751.0	10.5	56	Cloudy.
	10	750.7	12.5	60	Cloudy; wind northeast.
	11	750.5	14	62	Cloudy.
	12 m.	750.0	15	64	Do.
	1 p. m.	748.7	15.5	64.5	Do.
	2	748.2	15.5	64.5	Do.
	3	747.5	15.5	64.5	Do.
	4	747.0	14.8	63	Do.
	5	745.9	14.1	62	Do.
	6	745.3	13.5	61	Do.
14	7 a. m.	736.8	12	57	Rain storm.
	8	736.5	12	57.5	Do.
	9	736.8	12	57	Do.
	10	737.3	11.5	57	Do.
	11	737.6	11.5	57.5	Do.
	12 m.	738.3	11.5	57.5	Do.
	1 p. m.	738.8	11.5	57	Do.
	2	739.3	11.5	57	Do.
	3	740.0	11.5	57.5	Do.
	4	740.8	11.5	57.5	Cloudy.
	5	741.5	11.5	57.5	Northeast wind; sunshine.
	6	741.9	11.5	57	Clearing up.
15	6 a. m.	745.2	4	43	Cloudy.
	7	745.6	4	44	Clear.
	8	745.9	6	46	Sunshine.
	9	746.1	9	56	Do.
	10	746.1	11.5	58.5	Do.
	11	746.2	13	62	Do.
	12 m.	746.1	15.5	66	Do.
	1 p. m.	746.1	16.5	65.5	Do.
	2	745.9	16.5	65.5	Clear.
	3	745.2	16	64.5	Do.
	4	744.5	15	63	Do.
	5	744.1	14.5	62.5	
	6	743.7	12	60.5	
16	7 a. m.	736.9	12.5	59	Rain.
	8	735.8	13	59.5	Do.
	9	735.4	12.5	59.5	Do.
	10	735.2	13	60	Do.
	11	735.0	13	60	Do.
	12 m.	734.6	13	59.5	Do.
	1 p. m.	734.5	13	59	Do.
	2	734.5	13	60	Do.
	3	734.5	13	60	
	4	734.45	13	60.5	Do.
	5	734.7	13	60	Do.
	6	734.85	13	59	Do.
17	7 a. m.	736.7	11	58	Do.
	8	737.15	11	56	Do.
	9	737.6	11.2	57	Clearing up.
	10	737.85	11.8	57.5	Cloudy.
	11	738.2	11.8	57	Rain.
	12 m.	738.8	11.8	58	Sunshine.
	1 p. m.	739.0	12.5	59.5	Cloudy.
	2	739.05	13	60	Do.
	3	739.15	13	60	Do.
	4	739.55	13	59.5	Do.
	5	739.9	12.5	59	Do.

Barometrical observations—Continued.

Date.	Hour.	Barometer.	Thermometer—Cent	Temperature—Fahr.	Remarks.
1848.					
Sept. 17	6 p. m.	740 05	12.5	58.5	Cloudy.
18	7 a. m.	740.85	11	56	Do.
	8	740.90	11	56.5	Do.
	9	740.95	11.5	57	Do.
	10	741.00	11.5	58	Do.
	11	740 95	12	57.5	Rain.
	12 m.	740.9	12	58	Do.
	1 p. m.	740.85	12	58.5	Cloudy.
	2	740.85	12	59	Do.
	3	740.7	12.5	58.5	Rain.
	4	740.6	12.5	59	Cloudy.
	5	740.6	12 5	58.5	Do.
	6	740.6	12	57.5	Do.
19	7 a. m.	739 85	9.5	53.5	Do.
	8	740.05	9.5	53.5	Rain.
	9	740.0	9.5	54	Do.
	10	740.0	10	54	Do.
	11	740.0	10	54	Cloudy.
	12 m.	740.0	10	54	Do.
	1 p. m.	740.0	10	54	Do.
	2	740.1	9.5	54	Do.
	3	740.0	9 5	53.5	Rain.
	4	740.1	9	52.5	Do.
20	6 a. m.	741.7	6	47.5	Clearing up.
	7	741.75	6.5	49	Do.
	8	741.75	7	49	Cloudy.
	9	742.1	7.5	50.5	Do.
	10	742.3	8.5	52.5	Do.
	11	742 6	8.5	52	Do.
	12 m.	742.7	9	52.5	Sunshine.
	1 p. m.	742.85	9.5	52.5	Do.
	2	742.85	9.5	53	Do.
	3	743.1	9	51.5	Do.
	4	743 2	8.5	51.5	Cloudy.
	5	743.5	8	51	Do.
21	7	750.45	3.5	43	Clearing.
	8	750.6	5.5	47.5	Do.
	9	751.6	7	49.5	Do.
	10	752.2	8	51.5	Do.
	11	752.25	8.5	53.5	Cloudy.
	12 m.	752.35	9.5	54.5	Do.
	1¼ p. m.	752.75	10	54	Sunshine.
	2	752.6	10	54	Do.
	3	752.55	9	52	Do.
	4	752.4	8.5	51.5	Do.
	5	752.35	7.5	49.5	Do.
22	7 a. m.	752.6	1	39	Do.
	8	752.8	3.5	44.5	Do.
	9	753.15	5.5	49	Do.
	10	753 45	9	54	Do.
	11	753.45	10.5	56.5	Do.
	12 m.	753.45	12.5	60	Do.
	1 p. m.	753 4	13.5	62	Do.
	2	753.0	14	61.5	Do.

Barometrical observations—Continued.

AT LAKE SHORE.

e.	Hour.	Barometer.	Thermometer—Cent.	Temperature—Fahr.	Remarks.
3.					
22	3 a. m.	752.2	14.5	62	Sunshine.
	4	751.7	13.5	59	Do.
	5	751.45	12	58	Do.
	5½	751.4	10	54	Do.
23	6	748.2	5	47	Cloudy.
	7	748.1	8	53	Clear.
	8	748.0	10.5	56	Do.
	9	748.0	14	61	Do.
	10	748 0	17.5	66	Do.
	11	747.4	16	63	Cloudy.
	12 m.	747.0	16.5	64	Do.
	1 p. m.	746.35	14 5	60	Do.
	2	746.3	13	60	Rain.
	3½	746 0	12	60	Do.
	4	746.0	11.5	59	Cloudy.
	5	746.3	11	59	Do.
24	6	749.1	1.5	32	Clear.
	7	749.3	10	41	Do.
	8	749.85	10	45.5	Do.
	9 a. m.	760.0	10.5	48	Cloudy.
	10	750 0	10	49	Do.
	11	749.8	10	49	Clear.
	12 m.	749.6	10.5	50	Do.
	1 p. m.	749.0	10	50	Do.
	2	748.6	10	49	Do.
	3½	748.3	9.5	50	Do.
	4	748.1	9	48.5	Do.

Barometrical observations, 1848.

Date.	Hour.	Place of obeervation.				Remarks.
July 29	8 a. m.	Mouth of Montreal river	751.00	68 F.	64	Cloudy, and rain.
31	1¾ p. m.	....do....do	739.95	22.5 C.	67	Showers.
	3	....do....do	740.20	22	70	Strong west wind.
	5	....do.... o	740.40	20.5	66	Cloudy; west wind.
	6	....do....do	740.40	20 5	65	
August 1	6 a. m.	....do.... ....do	742.70	13.5	57	
	7	....do....do	744.10	19	64	Clear.
	8	....do....do	744.33	21.5	70	
	9	....do....do	745.00	24.5	74	
	10	....do....do	745.5	25.0	83	
	11	....do....do	745.5	26.5	80	
	12h. 20m.	....do....do	745.3	26.5	.....	
	12h. 35m.	Summit of terrace, above lake	742.85	26.2	72	

	8½ a. m.	.....do.....do.....	749.3	.....	71½
	9½.....	Level of Carp lake.....	736.5	.....	73
	10½.....	Level of Lake Superior.....	748.7	.....	76
	10½.....	.....do.....do.....	748.65	.....	76½
	2 p. m.	.....do.....do.....	747.45	.....	81½
	3.....	At Carp lake.....	734.8	.....	79½
	4.....	At Carp lake, west end, 5 feet above lake level.....	734 4	.....	76
	4h. 50m..	Location of Delaware Co.....	731.85	.....	78
	5h. 10m..	.....do.....do.....	731.70	.....	76
	6h. 15m..	.....do.....do.....	731.50	.....	74
August 7	6 15 a. m.	.....do.....do.....	730.15	.....	71½
	6h. 45m..	.....do.....do.....	730.15	.....	72
	7h. 45m..	(No. 1) Croton Co.'s location.....	727.5	.....	70½
	8h. 15m..	Jasper hill, near correction line.....	714.65	.....	69
	9h. 15m..	Little Carp river, township 50, range 44, sections 2 and 3.....	720.45	.....	74
	10.....	Township 50, range 44, $\frac{3\,|\,2}{10\,|\,11}$	714.15	.....	72½
	11.....	Township 50, range 44, section 11.....	709.20	.....	75
	2 p. m.	(No. 2).....	714.3	.....	78½
	2½.....	(No. 1) Croton Co.'s location.....	726.5	.....	80
	3.....	Delaware Co.'s office.....	726.85	.....	84
	4h. 45m..	Carp lake.....	731.1	.....	83
	5h. 15m..	Shore of Lake Superior.....	743.3	.....	85
	6½.....	.....do.....do.....	743.0	.....	82
August 10	1.....	Lake shore.....	747.2	.....	59½
	4h. 25m..	Summit of hill, township 51, range 42, section 16.....	731.0	.....	58
	5h. 30m..	Lake shore.....	747.15	.....	60
August 11	7 50 a. m.	....do.....	747.95	.....	60
	9.....	Union river works.....	740.00	.....	63
	11.....	Township 51, range 42, section 29, summit of Conglomerate hill.....	723.25	.....	61
	3 30 p. m.	Union river works.....	739.45	.....	69
	4h. 30m..	Lake shore.....	747.35	.....	61

Barometrical observations made in July, 1848, by J. D. Whitney.

Date.	Hour.	Place.	Bar.	T.	t.	Remarks.
July...11	6 p. m.....	Rapids of Ontonagon at Cushman's warehouse.....	29.266	80½	80½	Clear.
	7 p. m.....	....do.....do.....	29.250	75½	75	..do.
12	7 a m.....	....do.....do.....	29.308	75	74½	Sky overcast.
	8 a. m.....	....do.....do.....	29.330	81	81	....do.
	10 a. m.....	....do.....do.....	29.350	85	84	....do.
	2 p. m.....	....do.....do.....	29.402	75	75	Slight shower.
	6 p. m.....	....do.....do.....	29.436	73	72	Clear.
	8 p. m.....	....do.....do.....	29.430	65	65	..do.
13	6 a. m.....	....do.....do.....	29.604	59½	59	..do.
	8 a. m.....	....do.....do.....	29.620	66½	66	
	10 a. m.....	....do.....do.....	29.626	73	72	
	12 m.....	....do.....do.....	29.618	74	73½	
	2 p. m.....	....do.....do.....	29.600	74	73½	Sky overcast.
	4 p. m	....do.....do.....	29.586	73	72	Clear.
	6 p. m.....	....do.....do.....	29.540	68½	69	
	8 p. m.....	....do.....do.....	29.505	60	60	
14	7 a. m.....	....do.....do.....	29.450	64	63	
	8 a. m.....	....do.....do.....	29.458	69½	69	
	10 a. m.....	....do.....do.....	29.450	80	79	
	12 m.....	....do.....do.....	29.400	81	81½	
			Mill.			
	2 p. m.....	....do.....do.....	746.3	80	80	Barometer given in millimetres.
	4 p. m.....	....do.....do.....	745.4	79	78	
	6 p. m.....	....do.....do.....	744.6	77	77	
	8 p. m.....	....do.....do.....	743.5	70½	70	
15	6 a. m.....	....do.....do.....	741.2	67½	67½	Thunder and lightning during the night.
	8 a. m.....	....do.....do.....	741.6	74	75	
	10 a. m.....	At location of the Ontonagon Mining Company.....	727.2	80½	80½	
	11 a. m.....	On cliff above mine.....	723.5	80	80	

	2 p. m.	... do	...do	748.1	70	68	
	6 p. m.	... do	...do	747.7	66	65½	
	8 p. m.	....do	...do	747.3	58½	59	
19	10 a. m.	....do	...do	746.3	74	73½	Clear.
	12 m.	....do	...do	745.4	76½	76½	
	2 p. m.	....do	...do	745	74	73½	
	4 p. m.	....do	...do	744.2	75	75½	
	6 p. m.	....do	...do	743.6	71	71½	
20	6 a. m.	....do	...do	743.3	64½	63	
	8 a. m.	....do	...do	743.1	77	77	
	10 a. m.	....do	...do	742.4	83	82	
	12 m.	....do	...do	.....	.....	.....	
	2 p. m.	....do	...do	741.8	85½	84	
	4 p. m.	....do	...do	740	84½	82½	
	6 p. m.	....do	...do	739.5	80½	81½	
21	10 a. m.	....do	...do	740.6	69	69	Heavy thunder storm during the night.
	2 p. m.	....do	...do	741.3	68½	68½	Clear.
	4 p. m.	....do	...do	742	72	74	
	6 p. m.	....do	...do	742.5	66½	66½	
22	8 a. m.	....do	...do	749.3	67½	67½	
	12 m.	....do	...do	749.7	75½	75½	
	3 p. m.	....do	...do	749.6	75½	75½	
	6 p. m.	....do	...do	748.9	73	73	
23	6 a. m.	....do	...do	749.5	57½	57½	
	8 a. m.	....do	...do	750.1	71	71	
	11 a. m.	Ontonagon Company's location		735.5	75	75	
24 & 25	24th 4 p. m.	.....		.....	46	.....	Rain from noon of 24th to evening of 25th.
26	11 a. m.	Bluff at Ohio Trap Rock Company's location		728.7	56	56	Clear.
	1 p. m.	....do	...do	728.7	60	59	
	3 p. m.	Ontonagon river at bases of bluff		741.5	59½	61	Five feet above river.
	3½ p. m.	Bluff at location occupied by American Exploring Company		730.5	60	60½	
	6½ p. m.	Camp at Ohio Trap Rock Company's location		734.1	55	55	
27	10 a. m.	Porphyry hill, on location No —		725.6	59	61	

Barometrical observations—Continued.

Date.	Hour.	Place.	Bar.	T.	t.	Remarks.
July...27	2 p. m.....	Camp at Ohio Trap Rock Company's location.....	730.6	62	63	
	3 p. m.....	....do.....do.....	730.45	61½	61½	
	4 p. m.....	....do.....do.....	729.35	60	62	
	5 p. m.....	Ontonagon river.....	735.8	58	60	
	5½ p. m.....	Camp	729.2	58	58½	

Barometrical observations in 1848, *by W. Gibbs, M. D.*

ıte.	Hour.	Place.	Barometer.	Thermometer, Centigrade.	Temperature, Fahrenheit.
18.					
13	4 p. m...	Algonquin location.....	730.5	15.0	58.5
	5.....	.....do.....	730.3	18.5	56.0
	6	.....do.....	729.8	22.5	57.0
14	7 a. m...	Algonquin location—rain.....	720.4	21.0	53.0
	8.....	.....do.....do.....	721.0	20.5	53.0
	9.....	.....do.....do.....	721.0	20.5	51.5
	10.....	.....do.....do.....	722.0	21.5	52.0
	11.....	.....do.....do.....	722.8	23.5	52.0
	12 m....	.....do.....do	723.3	21.5	51.0
	3 p. m...	.....do.....do.....	724.8	22.0	53.0
	4	.....do.....do.....	725.0	21.0	52.5
	6	.....do.....do.....	726.9	23.5	51.0
15	7 a. m...	.....do.....	731.5	20.0	49.0
	8h. 45m..	South corner of township 52, range 37, sections 33 and 34.....	726.2	12.5	53.5
	11.....	Location house of D. Houghton Company...	733.3	15.5	60.0
	12 m.	.....do .....do.....do.....	733.3	17.0	63.5
	1 p. m...	Summit ridge, west of D. H. Co.'s location...	728.6	16.2	67.0
	1h. 25m	Summit of 2d ridge, w. of D. H. Co.'s location	726.7	18.0	71.0
18	9 30 a. m.	Summit of 1st Trap ridge, east of D. H. Co.'s cabins.....	723.6	11.0	58.5
	12h. 20m..	Summit of Conglomerate ridge, east of D. H. Co.'s location.....	728.7	14.0	58.5
20	8 a. m...	Cabin, Douglass Houghton Co.....	728.6	6.5	51.0
	9h. 55m..	Summit 1st Trap ridge, ½ mile southwest of D. H. Co.'s location.....	724.6	9.0	52.0
	2 p. m...	Summit of Trap ridge, a little north of $\frac{30}{35}\frac{29}{36}$	725.6	8.0	52.5
21	4 45 p. m.	Summit of Trap ridge, 2 miles west of southwest corner of tp. 37, a little south of line...	731.5	10.0	53.0
22	3h. 30m..	Summit of ridge, 1 mile south of northeast corner of (98) township.....	732.7	15.0	70.0
23	12 m.	Cabin of Ontonagon Co.....	732.5	19.0	67.0
	2 p. m...	Summit of Middle Brother.....	726.4	14.5	56.0
24	7 a. m...	Cabin of Ontonagon Co.....	734.5	3.5	35.0
	8h. 10m..	.....do.....do.....	734.55	4.5	38.5

) the last 4 observations no correction is to be applied for the ° point of the detached ther-ıeter; to all the others, however, a correction of — 1.5 must be applied.

Table of heights on the district between Portage lake and the Mo river.

Township 52, range 37, section 35, Algonquin location, mean of eight observations	
Township 52, range 37, southwest corner 34, highest point of elevated trap ridge	
Township 51, range 37, southwest corner 15, cabin of Douglass Houghton Company	
Township 51, range 37, southwest corner 15, trap ridge east of Douglass Houghton Company	
Township 51, range 37, southwest corner 15, conglomerate ridge half a mile east of Douglass Houghton Company	
Township 51, range 37, southwest corner 21, trap ridge one-eighth of a mile southwest of Douglass Houghton Company	
Township 51, range 37, southwest corner 30, trap knob near southeast corner	
Township 50, range 38, section 6, trap ridge in northwest corner of section	
Township 50, range 39, section 1, 12, trap ridge one mile south of northeast corner of township	
Township 50, range 39, section 16, cabin of Ontonagon Company	
Township 50, range 39, summit of Middle Brother	
Township 50, range 40, section 36, Ontonagon Company's clearing, mean	
Bluff mine of American Ex. Company, above Ontonagon	
Clearing of O. T. R. Company, above Ontonagon	
Hill of Red porphyry	.1
Red bluff of porphyry above its base	
Above lake	1
Base of red bluff	
Porphyry hill	
Carp lake	
Cliff at Isle Royale Company's mine	
Cliff above Carp lake	
Location of Delaware Company above Carp lake	
Location of Delaware Company above Lake Superior	
Union River works	
Township 51, range 42, section 30, conglomerate	
Township 51, range 42, section 16, hill of altered sandstone	
Croton Company's location	
Township 51, range 43, section 32, quartzose bluff	1
Highest point measured	1

s on the topography, soil, geology, &c., of the district between Portage lake and the Ontonagon.

he district which I have had the task of exploring, is that portion of northern peninsula of Michigan which extends along the southern re of Lake Superior, from the Portage to the mouth of Montreal river, nding southward as far as the boundary line between Michigan and consin. Its general shape is that of a nearly isosceles triangle, of ch the base would extend from near the northern extremity of Portage south to the Brulé river. This line is about 84 miles in length. The sides may be represented by straight lines—the northern drawn from Portage to the mouth of the Montreal river, the southern by one drawn where the range-line between 33 and 34 meets the Brulé river, to t the other. These two sides would each have a length of about 96 s, and the three would very nearly enclose the entire district. East e line considered as the base of the triangle, the character of the geocal features of the country begins to undergo a marked change, and limit taken as the boundary of this district to the east may therefore be sidered to be a natural one, although there is nothing in the character he general topography of the country which would indicate that this should be chosen in preference to any other.

his district embraces an area of about 4,000 square miles.

hat part of the district which lies north of the fifth correction line, or e which passes near the Anse and extends to the mouth of Carp river, subdivided in 1846 by Messrs. Higgins and Hubbard, with the exion of 5 townships lying near the Anse; these, with the exception of have been subdivided during the summer of 1848 by Mr. Higgins. th of the correction lines, the township lines were run during the sum- of 1847 by Messrs. W. A. and Austin Burt, and four townships lying he trap range, and near the Ontonagon, were subdivided by Mr. Higduring that season. During the past summer a large number of towns in this district have been subdivided by the Messrs. Burt and Mr.

The continuing the subdivisions over the whole district south of rap range, would add to our knowledge of the geography of the dis- but there is no reason to suppose that any land will be sold here for y years to come—that is, in the region south of the trap range. The ber of townships and fractions of townships in the whole district is t 130.

he topographical features of this region are not particularly striking. outhern boundary, elevated probably about 700 feet above Lake Su- r, is occupied by a great number of small lakes, of which Lac Vieux t is the largest, and but a few of which have received a name. These are the springs which feed the rivers flowing from this, the water- line; on the south, the Wisconsin and Chippeway rivers, with their erous branches, which flow into the Mississippi, and through it into Gulf of Mexico; and on the north, a number of comparatively small s, all which empty into Lake Superior. Thus it is evident that the eral descent of the whole region is from the south towards the north; in general it may be said that this descent is quite gradual, being en only by the ranges of trappean rocks which run through its entire nt in an easterly and westerly direction. The number of rivers is very , and of course they are comparatively small. By far the most con-

Barometrical observations made in July, 1848, by J. D. Whitney.

Date.	Hour.	Place.	Bar.	T.	t.	Remarks.
July...11	6 p. m.....	Rapids of Ontonagon at Cushman's warehouse.....	29.266	80½	80½	Clear.
	7 p. m.....	....do.....do.....	29.250	75½	75	..do.
12	7 a. m.....	....do.....do.....	29.308	75	74½	Sky overcast.
	8 a. m.....	....do.....do.....	29.330	81	81	....do.
	10 a. m.....	....do.....do.....	29.350	85	84	....do.
	2 p. m.....	....do.....do.....	29.402	75	75	Slight shower.
	6 p. m.....	....do.....do.....	29.436	73	72	Clear.
	8 p. m.....	....do.....do.....	29.430	65	65	..do.
13	6 a. m.....	....do.....do.....	29.604	59½	59	..do.
	8 a. m.....	....do.....do.....	29.620	66½	66	
	10 a. m.....	....do.....do.....	29.626	73	72	
	12 m.....	....do.....do.....	29.618	74	73½	
	2 p. m.....	....do.....do.....	29.600	74	73½	Sky overcast.
	4 p. m	....do.....do.....	29.586	73	72	Clear.
	6 p. m.....	....do.....do.....	29.540	68½	69	
	8 p. m.....	....do.....do.....	29.505	60	60	
14	7 a. m.....	....do.....do.....	29.450	64	63	
	8 a. m.....	....do.....do.....	29.458	69½	69	
	10 a. m.....	....do.....do.....	29.450	80	79	
	12 m.....	....do.....do.....	29.400	81	81½	
			Mil.			
	2 p. m.....	....do.....do.....	746.3	80	80	Barometer given in millimetres.
	4 p. m.....	....do.....do.....	745.4	79	78	
	6 p. m.....	....do.....do.....	744.6	77	77	
	8 p. m.....	....do.....do.....	743.5	70½	70	
15	6 a. m.....	....do.....do.....	741.2	67½	67½	Thunder and lightning during the night.
	8 a. m.....	....do.....do.....	741.6	74	75	
	10 a. m.....	At location of the Ontonagon Mining Company.....	727.2	80½	80½	
	11 a. m.....	On cliff above mine.....	723.5	90	89	Heavy thunder shower.

Michigan and Wisconsin. The largest lake is Agogebic, or Goge- said to be from the Chippeway word *ogibij*, a little fish.) This lake rincipally in townships 47 and 48, range 42, and is about 12 miles It forms the source of the west branch of the Ontonagon. Carp in the valley of the Porcupine mountains, is a beautiful sheet of . There are numerous lakes of small size in townships 52 and 53, s 35 and 36, none of which, however, have received names. Many se lakes abound in fish, principally bass, carp, and other small fish.

TOPOGRAPHY.

om what has been already said of the rivers, a general idea will have formed of the principal features of the country. In general it may be to be a rolling surface, gradually rising towards the south, and broken nges of precipitous heights, which traverse it in a general easterly westerly direction. From the Portage to the Ontonagon river, the of trappean rocks which characterizes Keweenaw point continues in rtheasterly and southwesterly direction, sweeping gradually round the extremity of the point, and dividing the country into two distinct ons—that to the north of the range being drained by rivers flowing at angles to it; that to the south by streams flowing parallel with it. trap range crosses Portage lake in township 55, ranges 33 and 34, has here a width of about three miles, and is distant about six miles the shore of Lake Superior, on the north. It continues its course hwesterly in a course nearly parallel with the shore of the lake, but ually increasing its distance from it, till at Agogebic lake its northern is about twelve miles distant from the shore of Lake Superior. Its width is about one mile, while at Agogebic lake it is nearly six s across from the northern to the southern limit. From Agogebic , proceeding westward it assumes a more nearly east and west direc- , and gradually approaches the lake shore, which trends to the south, e same time gradually increasing its width, till at Montreal river it is nt only 2½ miles from the lake, and has a breadth of fully ten miles. rom the lake shore to the trap range the country ascends gradually regularly till we reach the limit of the sandstone, when it rises more lly, but still without any abrupt elevation, till we find ourselves on dge of a precipitous escarpment, the trappean rocks being almost ut exception gradually inclined upon their northern flank, while to uth they are precipitous and abrupt. Crossing the trap ridges, we o the south and east of Agogebic lake a rolling plain, unbroken by onsiderable elevation, underlaid by the sandstone rocks, which are ionally seen cropping out in the beds of streams. In passing over ap range at right-angles to it, from the mouth of Misery river to the , we find the sandstone occupying a breadth of about six miles to the and eighteen miles to the south of the trap. This width gradually ases, and to the west of Agogebic lake the sandstone is no longer seen ace, except to the north of the trappean rocks, on the shore of the lake. stand on an elevated point of the trap range, along the west branch e Ontonagon, and look to the south, we perceive, as far as the eye each, a country entirely unbroken by any considerable elevations, and hing off apparently in an almost perfectly level plain. On traversing region it is found to be generally low and swampy, with occasional

slight elevations covered with maple, though the rock is rarely exposed This extends to the south boundary of township 47, where there is a low dike or ridge of trap rock—not, however, more than a mile in width. Beyond this we reach the region of greenstone and hornblende rocks, where the rocks occur in low ridges or knobs, mostly having an easterly and westerly direction, few of them rising more than a hundred feet above the general level, the intervals between them being filled with small lakes and swamps.

From the point where the trap range crosses Portage lake to near Agogebic lake, we have a regular band of trappean rocks pursuing a course nearly parallel with the lake shore, gradually narrowing one mile in width in township 52, range 36, and then expanding again, till at Agogebic lake it is about six miles in width. This, with the exception of this narrow belt of trap on the southern boundary of township 47, is the only range of trappean rocks between the lake shore and the south boundary of the sandstone, which is found both to the north and to the south of it. North and west of Agogebic lake, however, instead of the gradually descending plain of sandstone stretching uninterruptedly to the shore, we find a series of elevations rising suddenly from near the lake to the height of nearly 1,000 feet, while five or six miles from the lake they attain the height of about 1,400 feet—the highest elevation of any point on the northern peninsula of Michigan. These elevations constitute the system of the Porcupine mountains—a series of three tolerably distinct and nearly parallel ridges which extend from range 42 to range 44 obliquely through townships 50 and 51. Between this system of elevations and the Keweenaw point or Ontonagon range there is a valley of sandstone, almost level and marshy, of about seven miles in breadth. Directly south of the Porcupine mountains, and a little east of the Agogebic lake, the Ontonagon range begins to divide into two distinct systems of ridges which extend along to the west, gradually diverging from each other to beyond Black river, when they lose their distinct character as ridges, and the country becomes rolling, with here and there a low ridge or knob. The distance from one ridge to the other is, on the range-line between townships 45 and 46, about three miles, and the interval between these ridges is almost entirely filled by tangled swamps. Near the southwest extremity of Agogebic lake, in township 47, range 43, commences another belt of trappean rocks, which extends along nearly east and west, rising from one hundred to two hundred feet above the general level, and crossing Montreal river near the line between townships 47 and 48. Another belt of trap appears beyond Black river, near the lake shore, and extends along, forming a ridge of about two hundred feet in height, and crossing the Montreal river about three miles from its mouth.

The sandstone is continuous along the lake shore from Portage lake to the Montreal river, although its width varies considerably; to the south of the trap range of the Ontonagon, it is not seen in place to the west of Agogebic lake.

SOIL.

The soil of this extensive district is quite various in its character, as would naturally be expected from its various geological character. The decomposition of the sandstone which underlies so large a portion of this

district would, alone, form a sandy, infertile soil. The trap rocks, on the contrary, containing, as they do, a considerable quantity of lime and the alkalies, these elements are found in more considerable quantity in the soil which covers them. The subject of the decomposition of the trap rocks has been studied with care by Ebelmen. From his researches it is evident that, in the progress of the decomposition of the trap and basaltic rocks, the lime, magnesia, oxide of iron, and especially the alkalies, are gradually removed, together with a portion of the silica; while there remains behind a hydrated silicate of alumina, or clay, after the decomposition has reached its utmost limit. The enormous deposites of clay upon the Ontonagon and its tributaries and south of the trap range were, perhaps, formed in this way; and it will be noticed that in the vicinity of the trap range the soil is a clayey loam when the process of decomposition is still in full progress. Further south the soil gradually becomes more sandy, till we reach the limestone region, where the soil again undergoes a great change in its character. In general the best soil in this district is on the trap range and in the valleys of some of the principal streams. On the trap range the sub-soil is thick, and made up of angular and rounded fragments of sandstone, conglomerate, and trappean rocks, and occasionally a boulder of limestone, with many of granite, porphyry, and hornblende rock. On this is a thin layer of decomposed vegetable matter, intermixed with fragments of rocks, leaves, and twigs. The soil is not deep, but, being new, it is strong; that is to say, it contains a large proportion of substance in a suitable state for the nourishment of the growing plant, though a few years' cultivation would soon exhaust it.

The annexed analysis of a soil from the location of the Black River Mining Company, on Black river, will give a correct idea of the composition of the best trap soil of this district, as far as inorganic constituents are concerned.

This soil has produced an extraordinary crop of potatoes. It will be seen that the proportion of alkalies is large—much more considerable than has been found in the soils of New England. The quantity of lime, on the other hand, is quite small. The large quantity of iron shows that the soil is the product of decomposition of a rock containing a large quantity of that metal, as do the trap rocks of that region invariably.

The soil was thoroughly dried at 250° F., and sifted through a sieve sufficiently fine to remove all the undecayed vegetable matter.

Experience has shown that the soil will produce large crops of such plants as will bear the severity of the climate. Potatoes have hitherto been the staple article of produce; and a number of clearings have been made along the banks of the Ontonagon, and planted with that vegetable. The garden of the Mendenhall Company had, in 1847, a luxuriant growth of beans, peas, onions, and other kitchen-garden vegetables, although very late. Barley, oats, and buckwheat might be raised to advantage, and would be the natural crops for the climate. Wheat can hardly be considered a suitable crop, since the quantity of lime in the soil is too small to render it likely that the crop would not exhaust the soil: besides, the heavy body of snow which lies upon the ground nearly six months in the year would be likely to "winter-kill" it. The season is too short to allow of Indian corn being raised. Should the mines prove valuable, the surrounding country will be settled, and vegetables and fodder will be

raised in sufficient quantity for home consumption: otherwise, it is not to be presumed that much land will be taken up for agricultural purposes.

CLIMATE.

The register kept by the surgeon at Fort Wilkins will show the mean temperature of that part of the Lake Superior district; and the difference between that point and this would be very trifling. The climate is too cold and forbidding, and the winter too long, to attract emigrants, who prefer to settle and cultivate the soil. During the month of July, the days are very warm: the nights are, however, almost always cool and refreshing. The alterations of temperature are very sudden, and it is not a very uncommon thing for the thermometer to fall 40° in the course of 24 hours. The snow falls constantly during the winter, and accumulates on the surface to the depth of five or six feet. This great body of snow does not generally disappear entirely till some time between the middle of May and the first of June. Both in 1847 and 1848, the first frost occurred on the same day—the 9th of September. It was in both cases sufficiently severe to completely kill all vegetation. Snow fell in 1847 on Presqu'isle, at an elevation of 150 or 200 feet above the lake, on the 13th of September. By the 10th of October, winter has fairly set in, though portions of the month of November are often cheered by a mild and pleasant Indian summer. The whole of the month of October, 1847, was on Keweenaw point a succession of gales of wind and rain and snow storms. Such being the severity of the winter and the shortness of the summer, all access to the country being impossible during one-half the year, it is evidently useless to expect that the tide of emigration will ever flow to the southern shore of Lake Superior. In fact, it will not be settled for agricultural purposes as long as an abundance of land remains unoccupied in a more southern and genial clime. The climate has, however, one great advantage: it is undoubtedly one of the healthiest in the world, in spite of the sudden changes of temperature in the summer.

SCENERY.

The whole of this district is covered with dense woods, with the exception of small meadows, which were undoubtedly formerly the beds of small lakes. Hence it is difficult to form any idea of the appearance of the country; for it is only on the southern edge of the trap cliffs, and then only by climbing a tall tree, that a complete view can be obtained of the surrounding country. One of the most interesting points whence a satisfactory view of the trap range may be obtained is on the location of the Minnesota Company, where a ladder placed against a tall hemlock allows the spectator to elevate himself more than a hundred feet above the summit of the cliff, and furnishes the only entirely uninterrupted view in all directions which I have seen in this district. From this point nothing but unbroken woods can be seen in every direction, as far as the eye can reach. The view to the north is terminated by the lake, and the country is seen gradually descending in that direction, without any considerable break. To the south, the sandstone plains extend as far as the eye can reach, while a few low ridges may be seen in the farthest distance. The course of the streams may be traced by the change in the appearance of

oliage. East and west, the trap range is seen stretching along in a ession of knobs and hills rising a few hundred feet above the general , and pleasing the eye with their graceful outline. This view is ly the same in general character with that seen at various points of trap range. Red cliff, in township 49, range 42, sections 11 and 12, ds a grand view of the surrounding country, with Lake Agogebic in distance, and is itself an imposing object. It is a dark red porphyritic , and its peculiar color and precipitous sides make it a very con- uous object of this whole region, and we have given it the name characteristic of its appearance. The valley of Carp lake affords a sing succession of views, precipitous cliffs rising from the north side the lake to the height of four hundred feet.

There are many water-falls in this district. Those on the Montreal river very picturesque. This river falls at its mouth about 60 feet in one nearly pendicular fall; and below the fall, it has cut its way through a gorge in sandstone fully a hundred feet in depth. The fall is visible from the lake. ie upper falls, about three miles higher up the stream, are much more pic- esque. Here the stream crosses a number of alternations of trap and idstone; and after two separate cascades—which, however, are near h other, and may both be seen from the same point—it cuts its way ough a deep gorge with overhanging walls, which furnish a variety of nantic points of view. The falls themselves are almost unrivalled in turesque beauty. The upper fall is about forty feet, and the whole lume of the stream is precipitated over a shelving ledge of rocks, when, nding suddenly around a beautifully shaped pyramid of trap rocks wned by tapering firs, it is again precipitated, in three separate cas- les, over forty feet. Were this scene easy of access, it would soon come a place of common resort.

The scenery at the mouth of Presq'isle river is very romantic—the er having worn a deep gorge in the slaty sandstone, in which channel however, no longer runs, having taken another course to the lake. In neral, however, it must be confessed that the scenery upon this part of Lake Superior district is neither striking nor peculiar, and that the istant succession of woods and swamps, which are neither cheered by song of birds nor enlivened by flowers, is monotonous in the extreme.

GENERAL GEOLOGY.

The rocks which occur upon this district are in many respects similar hose of Keweenaw point; and what is said of that portion of the dis- , will apply equally in most respects to this. We have—

st. The *red sandstone* of Lake Superior—of which the age cannot be rmined by any evidence which I have been able to collect, as it is rely destitute of fossils, and lies directly upon the granitic rocks.

d. A bed of *fossiliferous limestone* of the lower silurian system, which irs in an isolated position, and has but a very limited extent, the ct nature of which, and its relation to the sandstone, cannot be deter- ed with certainty without a further and more extended examination, perhaps not at all.

l. The *trappean rocks*, which are generally designated in this district, hose who traverse it for the purpose of exploration, as the *trap range*.

h. *Granitic and sienitic rocks*, with hornblende and greenstone, ch seem in this district to be invariably associated with them.

1. *Sandstone.*

The sandstone is exposed along the coast at intervals, and sometimes for miles continuously from the Portage to the mouth of Montreal river. It forms on the lake shore generally perpendicular cliffs, rarely exceeding fifty feet in height.

In general, it may be said that the furthur removed it is from the trappean rocks, so much the nearer do its strata approach to being horizontal, and so much the lighter colored and more fragile does it become. Between Salmon Trout and Graveralt rivers, the strata of sandstone are finely exposed, rising from 50 to 75 feet in vertical walls. They are nearly horizontal, but have a slight dip of from 3° to 5° to the northwest. The rock is in alternate bands of a grayish or buff color, and a brick-red; or at other places, the red is scattered in circular and oval patches through the lighter-colored strata. The white portions are apparently more argillaceous than the darker ones, and evidently contain less oxide of iron. The vertical walls of the sandstone are hollowed out at their base, by the action of the waves and the frost, into caves and arched passages: of small dimensions, however, when compared with those exhibited on a grand a scale at the Pictured rocks. None of them have the base of the opening at any considerable height above the water, nor do they indicate a higher level of the lake at any previous period. Some of them, however, have a very considerable height, and the top of the arch is considerably above any point which the waves could reach even in the highest gales; but it is easy to see that an opening having been once effected, fragments would be continually loosened and detached by the alternate action of frosts and thaws, the rock being in many places filled with cracks and crevices, and falling into fragments at a blow. These fragments in many cases assume a distinct rhombohedral form, and in some instances the rocks may be seen to be traversed by distinct sets of fissures or cleavage-planes crossing each other at angles of 60° and 120°. Electric currents have usually been assigned as the cause of these lines of fissure, and they are probably in many respects analogous to planes of crystallization in their formation. I have obtained fragments of sandstone from Isle Royale, in which this tendency to a rhombohedral cleavage was so perfectly manifested that some fragments might have been mistaken for crystals of brown spar, so perfect were the edges and angles.

Along the shore, between Salmon Trout and Elm and Misery rivers, the sandstone has only a very slight dip; and it will be seen that south of this portion of the lake shore the trap range is very irregular, and consists of only a few conical knobs and elevations of very trifling and inconsiderable height. The distance from the lake shore to the northern edge of the trap is here about six miles. As the trap range rises more prominently and regularly, the sandstone begins to have a more considerable dip, which gradually increases, till, at the base of the Porcupine mountains, where the trap is only about a mile distant from the edge of the lake, and where it rises in a lofty ridge of a thousand feet in height, the sandstone is inclined at an angle of 30°. This angle it maintains pretty uniformly along the base of the Porcupine mountains, and wherever it is seen intercalated in the trap in the interior. Thus the bed of sandstone of only two or three hundred feet in thickness, which extends along the

ge to the north of Carp lake and river, has a dip of from 27° to 30° at rious points along its course.

As we recede from the Porcupine mountains westwardly, the dip de-ases again. At the mouth of Iron river, and along its bed for several iles inland, the strata of dark-colored slaty sandstone may be observed pping from 14° to 17°, in various directions, from N. 80° E. around to 65° E. Here its dip; and at the mouth of Presq'isle river the sand-ne dips to S. 65°, W. 10°; about one-half mile from its junction with e trap it dips to N. 8°, W. 30°.

The dip of the sandstone gradually increases till we arrive at Montreal er, where, at the lake shore, it is nearly vertical, and it is here about o miles from its junction with the trap, and it has then the same angle dip as at the lake shore. All these dips are taken north of the trap nge, where the rock is best exposed on the lake shore. South of the ap range the sandstone is almost invariably horizontally stratified, or so early so that little or no variation from a perfect horizontality can be de-cted. Close to the trap it dips to the south, however, at a high angle, t in a very short distance it becomes horizontal. According to Judge urt, it dips to the north at the southern edge of the Porcupine mount-ns. As a natural consequence of the dip of the sandstone, it will be seen at from the highest point of the trap range the ground falls off gradually the shore of the lake; while to the south, the country is level or rolling.

The lithological character of the sandstone varies considerably at dif-rent points. In general it is made up of the same reddish and buff-lored agglutination, of rounded grains of quartz, which composes the ndstone of Keweenaw point; but at some points it assumes a slaty struc-re, and a dark, almost black color, so that it strongly resembles argil-ceous slate. The same is the case with the sandstone of the Con-ecticut river valley. At the mouth of Iron river, the sandstone is dark-lored, but does not split into thin laminæ. A mile up the river it occurs thin strata, which may be obtained from one-eighth to one-quarter ch in thickness. Again, at Presq'isle river, near the mouth, and for e-half mile up its bed, the sandstone is thinly stratified, has a dark lor, and is decidedly argillaceous. It has been used by the Indians r carving pipes, although too hard for that purpose. At the mouth of ack river the same form of sandstone appears again, but it is here still re finely stratified and traversed by two sets of cleavage planes. The tent of surface covered by these dark-colored varieties of sandstone is t trifling compared with the whole surface underlaid by that rock. uth of the trap I have never seen this variety of rock; it is only an ac-lental variety of the sandstone, and gradually passes into it.

The sandstone is, as far as our district extends, we have reason to be-ve, wholly destitute of fossils, or organic remains of any kind whatever. pple-marks are exceedingly common and beautiful, and impressions or sts of sun cracks, which are quite common, are sometimes mistaken the remains of vegetables, or indistinct traces of organic plants. On southern edge the sandstone rests upon granitic rocks, while the rthern limit is the lake shore, so that we are left entirely without any ans of determining the age of this deposite, unless some light may be d upon it when the relative positions of the sandstone and limestone r the Anse shall have been studied with more care.

The sandstone on this district is, in general, much more destitute of

foreign minerals or veins than that of Keweenaw point. Veins of calc spar, of any considerable width, like those near Copper Harbor, are entirely unknown. A few thin veins and strings may be seen on the Love rock, and here and there a narrow seam of carbonate of lime, or sulphate of baryta, may be seen upon the lake shore. In the sandstone of Presq'isle river, there are a few thin strings of spar, but nothing of interest, although the rock is exposed for several miles.

Mining operations have, on our district, rarely been attempted on the sandstone or conglomerate. I am not aware that any native copper or black oxide has been found in either of these rocks, as on Keweenaw point, but the only ore of copper which has been found occurring here is the sulphuret, the gray variety. This has been found in considerable quantity at Mendenhall's location, and has been sufficiently worked to prove its valuelessness. It was contained in a gangue of carbonate of lime and sulphate of baryta, both of which minerals were found here beautifully crystallized. The same ore was found near Presq'isle river, on a location called Reese's, but in too small quantity to afford any reasonable prospect of being worked to advantage. All mining explorations seem to show that the veins of a mineral-bearing character in the sandstone, or conglomerate, decrease in the amount of ore they carry as we descend upon them, and it is hardly probable that any further explorations in the rock will take place, since all which have been begun have so signally failed.

At the junction of the sandstone with the trap, explorations have been carried on in several places, and the results have been by no means destitute of scientific interest, although they have settled the question as to the occurrence of valuable deposites of copper in any such locality. In the Porcupine mountains, where a thin stratum of bedded trap has been elevated to the crest of a range of cliffs, a good opportunity has been afforded to explore at its junction with the sandstone at its lower line of contact. The line of contact is generally marked by the occurrence of a seam of clayey or decomposed chloritic matter, which occasionally contains rounded masses of sparry sandstone. In the clayey matter, native copper has been found at several points, and occasionally in masses of considerable size. On descending upon such a locality, the amount of metallic copper seems to decrease rapidly; and I infer, from all I can learn, that it in fact disappears altogether. In one case, at the Union River works, there is an extensive bed of amygdaloidal chlorite rock intercalated between the trap and sandstone, with a similar streak of clayey matter on its lower side. In the chloritic mass, copper was disseminated irregularly through the mass in fine scabs, and especially in connexion with the amygdales of carbonate of lime, of which this metal often formed the exterior coating. In the clayey stratum, which was only a few inches thick, native copper was found in masses of considerable size, up to many pounds in weight. From all I could learn at the mine, I inferred that no such masses were found after sinking upon the bed a few feet.

I am unable to account for the occurrence of these masses of copper in so singular a position. They are evidently not true veins.

CONGLOMERATE.

The conglomerate is, as on Keweenaw point, the frequent accompaniment of the finely-grained and uniformly-textured sandstone. It occurs

ted and intercalated in it in such a manner as to leave no doubt of ir common origin and identity of age and position. We may con- ve the conglomerate to have been the result of more violent and less tracted action of water, which has not broken down and triturated particles of rock to such an extent. Large patches of conglomerate ur occasionally, enclosed entirely in the sandstone, in such a manner t their method of formation cannot be mistaken for a moment. In neral, it will be noticed with regard to the conglomerate, that at a dis- ce from the trap, and where the sandstone is nearly horizontal, the terials of which it is made up are finely comminuted, and no con- merate or coarse pebbles will be found near it; but as we approach the p, and as the angle of dip increases, the coarser will the materials be nd, out of which the sandstone has been formed, and the more fre- ent the occurrence of beds of conglomerate. Thus at the Portage the ndstone is fine-grained, while at the base of the Porcupine mountains more nearly resembles conglomerate, being in many places in fact a re agglutination of large pebbles and boulders. The same fact will ways be noted where the junction of the sandstone and trap is observed land. The sandstone does not repose directly on the trap, but a belt greater or less width of coarse pebbly rock will almost invariably be nd interposed between them. This will be admirably observed in the tural section furnished by the Montreal river. Here the trap is observed ternating with the sandstone or shale several times, while next above e last belt of trap we find a mass of conglomerate nearly 2,000 feet ick. This is cut through to the depth of 150 feet, and exhibits a riking view illustrative of the powers of those currents of water which aped together such a mass of materials. The boulders of which the nglomerate has been formed are often more than 18 inches in diameter, d are mostly hornblende rock, porphyry, and quartz rock. They are ld together by a very small quantity of a finely comminuted mixture of artzose material and calcareous matter.

On the southern side of the trap range I have never seen any con- omerate. Whether this is owing to the fact that the sandstone is so little posed on the southern side of the trap, or that different causes have erated on the two sides of the trap, I cannot say with positive certainty, t I am led by a variety of reasons to incline to the latter opinion.

TRAPPEAN ROCKS.

By far the most interesting portion of this district is that underlaid by ks of a trappean character, and generally known as the "trap range," ich is a convenient name by which to distinguish the belt of rocks ich forms so marked a feature in the region extending from the ex- mity of Keweenaw point to the Montreal river.

The general outline of the trap range has been already indicated. It mains to give some account of its lithological character; of the different rieties of trap, and of the method of occurrence of copper and silver, d their ores, in this rock.

To the west of the Ontonagon river the trap rocks are not characterized any great diversity of mineralogical character, but may be generally ssed under the head of compact trap. It is a homogeneous, compact, ely-crystalline mass, composed probably of hornblende and albite,

with magnetic oxide of iron scattered through the mass. It is in gen extremely little acted on by meteorological influences; the exterior b comes whitened to the depth of a few lines, and the crystalline struc of the rock is made more distinctly visible. The rock is rarely, if ev regularly prismatic in its structure, like basalt. On passing the Ont agon river the rocks of a trappean origin become much more varied i their lithological character. The following are the principal varieties:

1. *Compact trap*, similar to that described above; varying, however, co siderably in color and texture, and occasionally taking a large proport of chlorite and a greenish magnesian mineral into its composition. Sev varieties are exceedingly fine-grained and close in their texture, so th they break with an almost conchoidal fracture. Some varieties contain very large per centage of magnetic oxide of iron, and if a fragment ha a tolerably regular prismatic form, and has lain for some time on the su face, it acquires magnetic polarity. This presence of so large a propo tion of iron is undoubtedly the reason of the irregular variation of t magnetic needle, so well known to the linear surveyor in the distri underlaid by trappean rocks. The fluctuations of the needle often indica the presence of the trappean rocks, even when concealed by a thi covering of detritus and soil.

2. *Amygdaloidal trap.*

This variety of the trap is found here and there irregularly through th trap, though it is not by any means so general in its occurrence betwe the Portage and the Ontonagon as to the west of that stream. The ba of the amygdaloidal trap is generally a fine-grained, homogeneous, dar colored mixture of hornblende and albite, filled with amygdales of eve variety of size and shape up to an inch in diameter. These cavities a filled with different mineral substances. Between the Algonquin locati and Agogebic lake, epidote is a frequent accompaniment of the amygd loidal trap; west of that lake, it begins again to resemble more nearly tha of Keweenaw point, and large quantities of the zeolitic minerals enter in its composition. If epidote fills the cavities of the trap, it is often of radiated crystalline structure, sometimes forming very handsome and si gular specimens: generally the centre of each amygdale of epidote is occ pied by quartz, often crystallized. Sometimes the crystals are colore beautifully by a mixture of epidote. Such varieties, when the cavitie are large and frequent, form very beautiful and singular specimens. Th zeolitic minerals frequently form so large a portion of the rock, that i disintegrates and crumbles to pieces after a very short exposure. At th location of the Atlas Mining Company the zeolitic minerals are ver abundant, and not only fill regular amygdaloidal cavities in the rock, bu are distributed through it in large flat sheets, or vein like masses, lying irregularly through the rock.

3. *Porphyritic trap.*

This rock has as its base a fine-grained trap, in which are disseminated long and distinct crystals of felspar, which, being white, stand out very distinctly against the dark-colored base in which they are imbedded. The crystals of felspar are generally half an inch in length. Thi

ety of trap is found occasionally in loose blocks south of the trap ge; but I have not seen it in place in our district, or any very marked ety of porphyry with greenstone base.

4. *Trap breccia.*

know no other name by which to characterize a singular mixture of gdaloidal trap and a quartzose rock, like an altered sandstone, which irs at Cushman's, township 50, range 40, section 36. It seems to be oduct of the interfusion of trap and sandstone. A rock similar in racter may be found at various other points in this region. At the ted States Company's location, same township, section 34, the trap irs mingled with quartz, calc spar, and epidote, apparently the prod- of the interfusion of the epidotic trap with these minerals.

5. *Epidotic trap.*

This variety of trap occurs at many points of the trap range, and espe- ly near the Ontonagon river, both east and west of the main branch, over a space of several miles in extent. The compact trap often ses gradually into epidotic trap, the epidote gradually replacing the nblende, till the rock becomes a compact epidote rock. The seams quartz and calc spar, carrying copper ore, almost always accompanied epidote, the trap on each side of the seam being composed in large t of epidote, and gradually passing into a compact trap as the distance n the seam of quartz increases.

QUARTZOSE ROCKS.

1. *Compact quartz rock, or jasper.*

The rock occurs abundantly in mountain masses, the highest points he Porcupine mountains being made up entirely of massive quartz t, or jasper. Its structure and texture vary considerably at different its. The greater portion of it, however, is a homogeneous compact jas- of a deep brick-red color, sometimes traversed by thin seams and ven by planes of fracture lined with crystals of quartz. The whole earance of the rock is that of an erupted mass. The jaspery mass is sionally varied by numerous delicate, light-colored streaks or bands, torted so as to form an imperfect ribbon jasper. At other points par- s of white quartz are mingled with the red jaspery mass. The pact variety of quartz rock sometimes shows a gradual passage into rtzose porphyry, the jaspery mass showing here and there a crystal elspar imbedded in it.

2. *Quartzose porphyry.*

This variety of quartz rock occurs in very large masses, since the highest its of the trap range, in townships 49 and 50, range 42, are made up of rock. It is made up of a brick red quartzose base, in which are imbed- small crystals of white felspar, not generally exceeding an eighth of nch in length. Almost invariably, small rounded particles of vitreous

quartz are disseminated with the felspar crystals through the jaspery base. This porphyry has generally a trappean structure, breaking, by natural joints, in more or less prismatic blocks. A nondescript rock occurs in a low ledge which crops out in township 49, range 43, section 33. It has a feldspathic base of a light reddish color, through which irregular crystals of red felspar and small rounded fragments of quartz are disseminated and intermixed with a greenish mineral, which appears to be epidote. It differs entirely, in external appearance, from any rock found at any other locality in this district.

EPIDOTE ROCK.

The varieties of epidote rock are as numerous as those of the proper trappean rocks, in which hornblende and albite make the principal ingredients. They occur together, in fact, over a considerable portion of the district; and though, on the whole, the proper trap is by far the predominating rock, yet there are sections where the epidote occurs in almost mountain masses. The trap often passes, by nearly imperceptible gradations, into an almost pure massive epidote. The epidote is, however, often associated with quartz, which often forms nodules of considerable size in it. The epidote which occurs in seams and veins is, generally, quite pure, and often has a radiated crystalline structure, though distinct crystals of the mineral have not, thus far, been found. The epidote rock, like the proper greenstone trap, often becomes amygdaloidal in its structure, and has its cavities filled with quartz and calc spar, like the amygdaloidal trap. On the location of the United States Mining Company, township 50, range 40, section 35, the amygdaloidal trap and epidote rocks occur in alternate bands or layers, the cavities of the trap being filled with epidote and quartz and those of the epidote with quartz principally. The epidote is the almost constant accompaniment of the metallic copper in the district, and is, on that account, of great interest.

The occurrence of native copper, sometimes associated with silver, through the whole extent of the trappean rocks, is the matter of most particular interest connected with them. That the metal should be found at so many points, over so large an extent of country, and occasionally in masses of such unprecedented size, is a fact which has not its parallel elsewhere. Copper occurs at so many points, that it would be impossible to specify them all. In general, it may be said that from Portage lake on the Montreal river we have rarely searched with care at any point where the trap has been exposed over any considerable extent of surface, without finding a few specks or stains of that metal. In general all the copper of this region occurs in the metallic form. The few exceptions seem to have resulted from atmospheric agencies, the copper being near the surface of the ground, having become encrusted with or converted into red oxide or green carbonate. A few thin strings of yellow and gray sulphuret may occasionally be met with even in the trap rocks, but never in any considerably quantity. In the sandstone, the gray sulphuret is the only form of the metal which has been obtained in any quantity.

The mode of occurrence of this metal is in many respects similar to the deposites of the same on Keweenaw point; but the most promising and important localities in this district are in some respects quite unlike those on the point, which have been mined with the greatest prospect of success

There are four ways in which the copper occurs, and which deserve ticular notice in order to form a correct estimate of the probable success he mining operations undertaken in our district:

1. Native copper accompanies the zeolitic minerals which so frequently ur in the amygdaloidal trap, sometimes filling the amygdaloidal cavities the rock, and sometimes scattered through it in strings or bunches, ich, however, do not form true continuous veins. The trap near Black d Presq'isle rivers contains large quantities of laumonite scattered rough the rock, and accompanied by metallic copper. The quantity this metal is, in all the localities which we have seen of this kind, very inute; and, as there are no regular veins, no chance of profitable mining n be expected at any such locality. I have nowhere in our district en any appearance of a true vein of copper having as its gangue the zeitic minerals—that is to say, like those which have proved the most productive of Keweenaw point.

2. The occurrence of masses of native copper occasionally of considerble size between the sandstone and the trap, has been already noticed. everal such deposites have already been sufficiently tested and deservdly abandoned. It seems evident that such deposites do not enrich on escending, but, on the contrary, that they decidedly grow poorer a short istance below the surface.

3. Throughout the whole extent of this district, but especially in the egion of Agogebic lake, copper occurs, disseminated in fine particles rough the massive epidote or epidote rock, which is found in very numerous localities. The epidote sometimes appears to traverse the trap in asses of considerable length and thickness, which assume somewhat ne form of regular veins. Such, however, they are not, since they have o definite dip or direction, nor are they separated from the trap by any xed walls or selvages, but, on the contrary, they pass into it by a gradal change in the nature of the rock. So extensive are these masses of pidote in the Porcupine mountains, and in some portions of the Ontonaon trap range, that it must be considered as a proper rock, which might e quarried in unlimited quantity. It is a very interesting fact, that these asses of epidote are so generally accompanied by native copper, that herever the epidote occurs, diligent search will almost invariably detect ne presence of at least a few particles or scales of that metal, which, inced, sometimes occur in very considerable quantity. It is generally attered through the epidote in fine particles—often, though, in thin sheets strings. Sometimes the whole mass of rock contains the copper equably attered through it in very fine particles of uniform size, and in sufficient antity to make up 10 to 20 per cent. of the whole mass. Very large sses occur also in the epidote, one weighing about —— tons having en found at the location of the Minnesota Company, in the bottom of open cut of unknown antiquity, where it had been loosened and dehed from the rock. The famous Ontonagon copper rock, as it has g been called, was also undoubtedly detached from an epidote bed, ce portions of this mineral are still adhering to it. The general simity between the nature of the deposites of copper upon Isle Royale and se of the Ontonagon, will be noticed by all who have visited both of se regions. I do not consider that there is much prospect of profitable ning operations being carried on on localities of this nature, the width he deposite of epidote being uncertain, as well as the quantity of cop-

per which it carries. Nothing but actual experience in working a mine of this description, will justify an opinion being formed of its value.

4. The principal deposites of copper in this district are in what are usually called, by those working them, east and west veins. These merit especial attention, since the quantity of metal which they have furnished is much more considerable than that obtained from any other kind of deposites of this metal in the trap between Portage lake and the Montreal. The true nature of these deposites I do not yet consider as satisfactorily settled, the explorations being thus far quite limited. They are, however, not injected veins, and I cannot consider them as identical with the productive veins on Keweenaw point. The following are the principal appearances at localities of this description: The trap here, as elsewhere, is divided into beds or parallel plates, generally of from four to six feet in thickness. These divisions or joints may sometimes be traced along for a considerable distance, following the course of the range, and dipping generally to the north at a high angle, generally from 30° to 45°. Sometimes, when the rock is exposed, a number of such joints may be seen in succession, one above another. The surfaces of the two masses of rock are sometimes in contact with each other, without any other appearance than a mere seam or crack in the rock; the surfaces, however, being sometimes coated with argillaceous matter, hardened and grooved, or highly polished. Often, however, a band of quartz and calcareous spar, associated with massive and radiated epidote, will be found extending along for a considerable distance at the joint, now diminishing to a mere thread, and then widening out to a foot or more. The epidote will often be found sometimes on one side and sometimes on the other of the joint, tolerably pure near it, and gradually passing into trap at a little distance from it. Connected with the quartz and epidote occurs the metallic copper, in fine grains, plates, and masses of all sizes, up to several tons in weight. Mining operations have been commenced at several points on localities of this nature, and a considerable quantity of metal has been raised. Several companies had discontinued their operations before we had an opportunity of visiting their works, and their shafts having become filled with water, we had no other means of forming an opinion of their real value than from the rock and metal thrown out and left exposed upon the surface. Two or three companies have been engaged in mining during the winter, and a much better opinion may be formed of the value of such deposites after the results of the winter's work shall be known. Should they be found to have enriched in descending, they may prove profitable, otherwise they will probably be abandoned. The quantity of copper in this district must be large, although much scattered; and from the occurrence of masses of so large a size as have been found loose upon the surface and in the rock, it seems not unreasonable to suppose that some deposites of value may be found.

In considering what portion of the trap range ought to be sold as mineral lands, I have endeavored, as far as possible, from the observations already collected, to determine where there is the greatest prospect of mining with success. The mere occurrence of copper ought not to be considered as a sufficient reason for designating the section as mineral land, since we have shown that copper occurs in innumerable localities where there is no prospect of mining with success.

The following sections include, in my opinion, all those portions of

trap range where there is the least reason to suppose that copper oc-
rs in any considerable quantity, but I by no means intend to say that
ery section contains a workable deposite of copper; on the contrary, it
ems not yet certain that there exists a single one which will prove a
arce of remuneration to the proprietors, nor can it be decided without
nsiderable expenditure of money.

Sections designated as mineral lands.

Township 52, range 37, sections 36, 35, and 34 (south half.)
Township 51, range 37, sections 1, (northwest quarter,) 2, 3, 4, (west
lf,) 11, (except southeast quarter,) 10, 9, (east half,) 15, (except south-
st quarter,) 16, 22, (northwest quarter,) 21, 20, (except northwest quar-
,) 28, (west half,) 29, 30, 32, and 31.
Township 51, range 38, sections 36 and 35.
Township 50, range 38, section 6.
Township 50, range 39, sections 1, 2, (except northwest quarter,) 12,
, 10, 9, (except northwest quarter,) 14, (except southeast quarter,) 15,
, 17, 18, 22, (except southeast quarter,) 21, 20, 19, 28, (north half,)
, 30, 31, (except southeast quarter.)
Township 50, range 40, sections 25, (south half,) 26, (south half,) 36,
, 34, 33, 32, and 31.
Township 49, range 40, sections 1, (north half,) 2, 3, 4, 5, 6, 7,
d 8 (north half.)
Township 49, range 41, sections 1, 2, 3, (southeast quarter,) 12, 11,
, 9, and 8 (east half.)

ASTRONOMICAL OBSERVATIONS.

In accordance with your instructions, I have made observations at seve-
points for the purpose of ascertaining the rates of the chronometers
nich were under your charge, and also for determining the latitude and
ngitude of some of the most important points within my district.
ese observations, with the calculated results, are herewith annexed.
Every one who has visited Lake Superior will have noticed the singu-
phenomena of mirage which are exhibited so commonly during the
mmer, and which distort and convert into so many fantastic shapes the
sts and adjacent country. The hills sometimes appear lifted up to two
three times their original height, vessels appear to be sailing in the air,
ints of land are bent upwards at right-angles, and the sun at setting is
en distorted into the most singular shapes. These appearances are
doubtedly caused by the alternations of temperature, so easily caused
a change in the currents of air blowing across the lake; by which
dies of air which are saturated by the evaporation over the surface of
e lake are mingled and interstratified with colder and dryer strata
ming from the land.
The effect of these phenomena on observations of angular altitude
ken by instruments will be evident, and it need hardly be said that on
ny days the observations are found to be utterly valueless. On a clear,
al day, with a brisk wind blowing steadily from one point, the obser-
tions have been found to agree well with each other; while on other

warm, sultry days, with light and changeable currents of air, the results of observations have shown a very variable refraction.

All observations during the night seem to be worthy of little confidence, and we have confined our observations entirely to altitudes of the sun. Observations for time were taken about 8 a. m., since it was found that refraction was most steady at that time. On a warm sunshiny day the amount of refraction increases rapidly, and to such a degree that our afternoon observations, which never agreed with each other, always gave the chronometer as from five to ten seconds slower in the afternoon than on the morning of the same day, the sun being at about the same altitude.

In the time observations, sets of three or six were generally taken, and two or four sets, which were separately calculated and compared with each other, if the weather was favorable. In the morning the different sets were found to agree within 0″.1, and all were rejected in which the difference was greater than 0″.4. In the afternoon the difference was as great as two or three seconds; and sets of observations, taken consecutively for an hour or more, when calculated showed a constantly-increasing angle of refraction.

The chronometers have not proved themselves to be worthy of confidence, as they have by no means kept a constant rate during the summer. It was not to be supposed that they should not change their rate at all; but as they were carried with the greatest care, it seems unaccountable that they should have changed their rate so materially.

The following were the rates given with the chronometers in Boston:

June 19, 1848.—No. 1122, 46″.2 fast of Boston time, gaining 1″.3 per day. No. 1141, 25″.7 fast of Boston time, gaining 2″.2 per day.

Comparison of the chronometers with each other.

		min.	sec.	
June	27.....	0	38.5	No. 1122 fast of No. 1141.
	28.....	0	41 5	
	29.....	0	45	
	30.....	0	48	
July	1.....	0	50.5	
	2.....	0	54	
	3.....	0	57.5	
	4.....	0	58.5	
	5.....	1	3.5	
	6.....	1	6.5	
	7.....	1	11	
	8.....	1	16 5	
	9.....	1	14.5	
	10	1	17.5	
	11.....	1	10.5	
	12.....	1	11.5	
	13.....	1	14	
	14.....	1	18	
	15.....	1	19.5	
	16.....	1	23.5	
	17.....	1	25	
	18.....	1	28.5	
	19.....	1	33.5	
Aug.	28.....	0	23	No. 1141 fast of No. 1122.
	29.....	0	27	
	31.....	0	28	
Sept.	25.....	1	38	
	26	1	40.5	
	28.....	1	44	
	29.....	1	46	
	30.....	1	47.5	

By observations at Sault Ste. Marie, from July 1 to July 6, the rates of the chronometers were—

1122 gaining 3″.38 per day.
1141 gaining 0″.18 per day.

By observations at Copper Harbor, from July 12 to July 16—

1122 gaining 3″.62 per day.
1141 gaining 0″.62 per day.

By observations at Copper Harbor, July 16 and August 29—

1122 gaining 0″.74 per day.

By observations at Ontonagon, from July 25 to August 19—

1122 gaining 0″.70 per day.

By the rates determined at Sault Ste. Marie, the difference of longitude between Boston and Sault Ste. Marie is—

By 1122, in time, 5ʰ 58′ 58″.49.
Arc, 13° 14′ 37″.5.
By 1141, in time, 5ʰ 53′ 6″.89.
Arc, 13° 16′ 43″.5.
Mean arc, 13° 15′ 40″.5,
Longitude of Sault Ste. Marie.

Copper Harbor.

Difference of longitude between Boston and Sault Ste. Marie, by rates determined at Sault Ste. Marie—

By 1122, in time, 1ʰ. 6′ 46″.41.
Arc, 16° 41′ 30″.
By 1141, in time, 1ʰ. 7′ 9″.
Arc, 16° 47′ 15″.

Difference of longitude between Copper Harbor and Ontonagon river, by observations July 19 and 25—

Time, 5′ 40″.71.
In arc, 1° 25′ 10″.5.

By observations August 18 and 29—

In time, 5′ 44″.27.
Arc, 1° 26′ 3″.

Copper Harbor and Black river—by observations July 19 and 28—

8′ 33″.
Arc, 2° 8′ 15″.

SAULT STE. MARIE, JUNE 22, 1847.

TIME OBSERVATIONS.

Deg.	*min.*	*sec.*	*h.*	*min.*	*sec.*
83	47	50	8	44	20
84	39	5	8	46	40
85	15	20	8	48	38
85	51	25	8	50	15

neter 29.47; thermometer 64°. Index error 20″+. Dr. Jackson's watch too fast 14′ 30″.

SAULT STE. MARIE, JUNE 22.

h.	*min.*	*sec.*	*Deg.*	*min.*	*sec.*
4	53	32	61	56	35
4	54	38	61	13	40
4	56	1	60	45	10
4	57	46	60	7	45
4	59	4	59	40	30

SAULT STE MARIE, JUNE 24, 1847.

h.	*min.*	*sec.*	*Deg.*	*min.*	*sec.*
8	3	53	55	26	55
8	4	5	55	52	40
8	6	42	55	55	20
8	7	34	57	4	35
8	8	46	57	30	10
8	9	40	57	16	10
8	10	49	58	9	30
8	11	16	58	19	35

Barometer 29.58; thermometer 68°. 57′ 36″.

SAULT STE. MARIE, JUNE 24.

	h.	min.	sec.		Deg	min.	sec.
—	11	54	55		126	31	30
—	11	58	16		127	10	10
—	11	51	26		127	26	50
—	12	44	12		132	58	30
+	12	45	36	—	133	7	15
				—	133	4	35
				Y +	133	13	30
+	12	47	36	W —	133	7	25
			36	Dr. +	133	22	30
	12	52	55	W —	133	19	15
			55	+	133	28	00
	12	54	18	—	133	20	10
	12	56	15	+	133	26	00
	12	58	00	—	133	19	55
				—	133	28	20
	12	59	35	+	133	26	45
				—	133	22	20
	1	1	43	+	133	26	15
				+	133	24	45
	1	2	51	—	133	21	20
				+	133	23	45
	1	3	57	—	133	20	10
				+	133	23	00
	1	5	21	—	133	19	50
				+	133	22	15
	1	6	34	—	133	17	35
				—	133	16	45
	1	7	38	+	133	19	00
				—	133	14	40
	1	8	45	+	133	16	15
				—	133	13	5
	1	10	38	+	133	12	00
	1	12	4	—	133	9	50
	1	13	45	—	133	4	30
				+	133	4	15
	1	14	53	—	133	0	25
	1	15	34	—	132	57	35
				+	132	51	30
				—	132	51	35

☌ JUNE 24.

	h.	min.	sec.	Deg.	min.	sec.
1.	12	47	36	133	7	25
2.	12	52	55	133	19	15
3.	12	54	18	133	20	10
4.	12	56	15	133	19	55
5.	12	58	00	133	23	30
6.	12	59	35	133	22	20
7.	1	31	43	133	21	20
8.	1	2	57	133	20	10
9.	1	3	57	133	19	50
10.	1	5	21	133	17	35
11.	1	6	34	133	16	45
12.	1	7	38	133	14	40
13.	1	8	45	133	13	5
14.	1	10	38	133	9	50
15.	1	12	4	133	4	30
16.	1	13	45	133	0	25
17.	1	14	53	132	57	35
18.	1	15	34	132	51	35

Barometer 27.54; thermometer 77°.

COPPER HARBOR, SATURDAY, JUNE 26.

	h.	min.	sec.	Deg.	min.	sec.
☉	5	0	9	78	20	15
☉	5	1	23	79	0	50
☉	5	4	5	77	2	30
☉	5	7	49	75	45	30
☉	5	11	37	74	29	55

Barometer 29.22; thermometer 73° F. Index error 0.

COPPER HARBOR, SUNDAY, JUNE 27.

TIME OBSERVATIONS.

☉	h.	min.	sec.	Deg.	min.	sec.
☉	9	21	13	75	56	10
☉	9	22	5	77	17	25
☉	9	23	14	76	37	20
☉	9	24	6	77	59	15
☉	9	25	9	77	16	20
☉	9	26	8	78	39	55
☉	9	32	23	80	43	50
☉	9	34	31	80	22	45
☉	9	36	4	81	57	55
☉	9	37	37	82	51	30
☉	9	38	45	82	10	45
☉	9	40	4			

Barometer 29.34; thermometer 68°. Index error of Dis. séxtant 2′ 5″.

COPPER HARBOR, JUNE 27.

TIME OBSERVATIONS, BY DR. JACKSON.

	h.	min.	sec.	Deg.	min.	sec.
☉	6	47	31	62	24	45
	6	50	54	61	15	00
	6	53	00	60	33	15
	6	54	49	59	56	45

COPPER HARBOR, JUNE 28.

MERIDIAN ALTITUDES OF ☉ FOR LATITUDE.

		h.	min.	sec.	Deg.	min.	sec.
☉	1.	12	57	51	130	52	50
☉	2.	12	59	14	131	51	35
☉	3.	1	0	21	130	52	25
☉	4.	1	1	29	131	56	5
☉	5.	1	2	19	130	56	25
☉	6.	1	3	23	132	1	0
☉	7.	1	4	16	131	0	35
☉	8.	1	5	27	132	5	5
☉	9.	1	6	39	131	4	20
☉	10.	1	7	34	132	9	0
☉	11.	1	8	53	131	7	25
☉	12.	1	9	52	132	11	15
☉	13.	1	11	13	131	9	35
☉	14.	1	12	16	132	12	55
☉	15.	1	13	43	131	11	10
☉	16.	1	15	26	132	13	45
☉	17.	1	17	26	131	8	55
☉	18.	1	18	25	132	11	35
☉	19.	1	19	33	131	7	45
☉	20.	1	21	5	131	40	55
☉	21.	1	22	39	131	4	5
☉	22.	1	24	46	131	36	0
☉	23.	1	25	44	132	1	10

COPPER HARBOR, JUNE 27.

h.	min.	sec.	Deg.	min.	sec.
1	1	0	130	58	55
1	2	5½	131	1	35
1	3	25½	131	4	30
1	4	25½	131	5	30
1	5	47	131	8	35
1	6	30½	131	9	55
1	7	14	131	10	30
1	7	59	131	12	35
1	8	45	131	13	20
1	9	59	131	13	45
1	10	43	131	14	35
1	12	4	131	16	5
1	13	37	131	16	55
1	14	44	131	16	45
1	16	23	131	16	20
1	17	30½	131	15	10
1	18	30	131	12	35
1	20	14	131	12	20
1	20	51	131	12	0
1	21	38	131	11	0
1	22	32	131	9	30
1	24	1	131	6	55
1	24	43	131	5	0
1	25	22½	131	3	30
1	26	12	131	1	25
1	26	53	131	0	5
1	27	47	131	57	55

Barometer, 29.37; thermometer, 75°; index error — 5″.

h.	min.	sec.	Deg.	min.	sec.
1	18	56	131	5	0
1	19	57	132	7	5
1	21	45	131	2	50
1	23	30	132	3	35
1	24	44	130	59	15
1	27	11	131	58	30
1	28	15	130	53	40
1	29	10	131	52	30
1	30	14	130	49	10
1	31	34	131	47	15

EAGLE RIVER P. O., JUNE 30.

P. M. ☉	h.	min.	sec.	Deg.	min.	sec.
1	5	5	33	77	7	10
2	5	6	51	76	39	5
3	5	7	53	76	19	10
4	5	8	50	76	0	0
5	5	9	55	75	38	15
6	5	10	40	75	23	50

Barometer 29.2; thermometer 80°. Index error 25″.

EAGLE RIVER P. O., JULY 1, A. M.

LOWER LIMB.

Deg.	min.	sec.	Deg.	min.	sec.
9	27	57.5	77	9	15
	28	44	77	25	15
	29	30	77	43	5
	30	33	78	6	5
	31	42	78	26	35
	32	24	78	29	20
	33	5.5	78	57	10

COPPER HARBOR, JUNE 29—(Commence at 1 p. m.)

MERIDIAN ALTITUDES OF ☉.

	h.	min.	sec.	Deg.	min.	sec.
1 ☉	1	0	15½	130	43	35
2 ☉	1	1	42	131	53	5
3 ☉	1	3	45	130	52	35
4 ☉	1	5	2	131	59	15
5 ☉	1	6	45	130	59	5
6 ☉	1	8	27	132	4	55
7 ☉	1	9	21	131	3	5
8 ☉	1	11	10	132	7	0
9 ☉	1	12	49	131	3	30
10 ☉	1	15	31	132	7	5
11 ☉	1	17	35	131	3	30
12 ☉	1	18	50	132	6	30
13 ☉	1	20	53	131	1	25
14 ☉	1	22	4	132	2	10
15 ☉	1	23	26	130	56	45
16 ☉	1	25	27	131	57	15

Barometer 29.43; thermometer 66°.

EAGLE RIVER P. O., JUNE 30.

MERIDIAN ALTITUDE OF ☉.

h.	min.	sec.	Deg.	min.	sec.
12	54	3	130	36	55
1	0	13½	131	43	5
1	1	22	130	43	40
1	2	29	131	49	50
1	3	34	130	49	55
1	4	39	131	55	35
1	5	47	130	55	15
1	6	58	131	59	55
1	9	41	131	2	10
1	11	6	132	6	40
1	13	35	131	4	20
1	14	39	132	8	45
1	15	58	131	6	0
1	17	22	132	8	15
1	27	9	130	55	40
1	28	57	131	56	20
1	29	16	130	50	0
1	30	23	131	48	55

COPPER HARBOR, JUNE 28, P. M.

TIME OBSERVATIONS.—(DR. JACKSON'S WATCH.)

h.	min.	sec.	Deg.	min.	sec.
5	26	27	69	34	5
5	27	35½	70	14	15
5	28	54	68	46	55
5	30	14½	68	21	10
5	31	20	67	57	20
0	0	0			
5	34	42	67	49	40

Barometer 29.50; thermometer 68°. Index, + 35.

COPPER HARBOR, JUNE 29, A. M.

TIME OBSERVATIONS.—(DR. JACKSON'S WATCH.)

	h.	min.	sec..	Deg.	min.	sec.
☌	9	7	52	71	9	29
☍	9	8	59	72	36	25
☌	9	10	7	71	57	30
☍	9	10	58½	73	18	5
☌	9	12	10½	72	38	30
☍	9	13	26	74	5	50

Barometer 29.47; thermometer 65°.

COPPER HARBOR, JULY 4, 1847, A. M.

☌	h.	min.	sec.	Deg.	min.	sec.
	9	27	29	76	59	55
	9	28	39	77	24	5
	9	29	41	77	45	15
	9	30	33	78	1	25
	9	31	18	78	17	25
	9	32	25	78	40	5

Barometer 29.5; thermometer 75°. Index error 5″.

COPPER HARBOR, JULY 4.

MERIDIAN ALTITUDES OF ☉.

☉	h.	min.	sec.	Deg.	min.	sec.
1.	1	2	37	130	8	20
2.	1	3	50	130	10	25
3.	1	5	6.5	130	13	10
4.	1	6	9.75	130	14	0
5.	1	7	14	130	17	35
6.	1	8	15.5	130	18	10
7.	1	9	18	130	18	50
8.	1	10	23.75	130	19	35
9.	1	11	25	130	20	20
10.	1	13	29.33	130	21	40
11.	1	14	28.50	130	22	25
12.	1	15	25.75	130	22	45
13.	1	18	27	130	21	40
14.	1	22	23.75	130	20	45
15.	1	23	53.50	130	15	35
16.	1	24	54.5	130	13	40
17.	1	26	40.75	130	12	25
18.	1	27	24	130	10	20
19.	1	28	36.50	130	5	40
20.	1	29	45	130	3	30
21.	1	30	34.25	130	1	25
22.	1	31	16.25	129	59	30
23.	1	32	6.50	129	57	35
24.	1	32	57	129	53	25

COPPER HARBOR, JULY 4, 1847.

TIME OBSERVATIONS.

☉	h.	min.	sec.	Deg.	min.	sec.
	5	56	57	59	3	45
	5	58	56.5	58	25	0
	5	59	58.75	58	4	0
	6	0	44.25	57	47	35
	6	1	45.25	57	28	15
	6	2	38	57	9	30
	6	3	34.5	56	52	25
	6	4	46.5	56	27	50

COPPER HARBOR, JULY 5, A. M.

LOWER LIMB.

h.	min.	sec.	Deg.	min.	sec.
9	49	55	84	17	55
9	50	49	84	37	20
9	51	35	84	50	10
9	52	26	85	10	55
9	52	59	85	19	55
9	53	41	85	33	35

Barometer 29.50; thermometer 75°.

COPPER HARBOR, JULY 5.

☉	h.	min.	sec.	Deg.	min.	sec.
	1	3	6	129	57	15
	1	3	55	129	58	10
	1	4	46	130	0	20
	1	5	41	130	2	0
	1	6	47	130	4	40
	1	7	27	130	5	40
	1	8	21	130	8	0
	1	10	22	130	10	5
	1	12	54	130	10	55
	1	14	38	130	11	50
	1	15	54	130	12	0
	1	18	19	130	10	35
	1	21	1	130	9	25
	1	21	34	130	8	10
	1	22	49	130	6	35
	1	24	8	130	4	25
	1	25	35	130	3	35
	1	26	29	130	1	5
	1	27	20	129	58	35
	1	28	4	129	57	15
	1	28	53	129	56	35

Barometer 29.45; thermometer 80°.

FORT, SAULT STE. MARIE, JUNE 29, 1848.

TIME OBSERVATIONS.

h.	min.	sec.	Deg.	min.	sec.
5	38	43	59	11	50
5	39	46.5	58	50	05
5	40	44.5	58	32	30
5	41	36	58	12	30
5	42	39	57	50	45
5	43	51	57	26	25

Barometer 29.250; thermometer 77°. Index error + 10″.

FORT, JUNE 30, 1848. (C. 1122.)

LATITUDE OBSERVATIONS.

h.	min.	sec.	Deg.	min.	sec.
12	46	1.5	132	35	40
12	47	56	132	39	15
12	49	19	132	41	55
12	51	25	132	44	45
12	55	3	132	49	25
12	56	.14	132	51	10
12	57	25.3	132	51	55
12	58	30	132	51	00
1	1	51	132	48	20 (?)
1	2	44	132	47	00
1	3	42	132	45	40
1	4	40	132	43	50
1	5	31	132	42	55
1	6	24.5	132	41	55
1	7	37.5	132	39	20
1	8	20	132	37	10

Barometer 29; thermometer 70°.

SAULT STE. MARIE, BARRACKS, July 1. (C. 1122.)

h.	min.	sec.	Deg.	min.	sec.
9	13	24	78	40	35
9	14	48	79	11	20
9	15	26	79	24	55
9	16	1	79	37	30
9	16	56	79	54	25
9	17	44	80	9	55
9	18	22	80	25	40
9	18	46	80	31	30
9	19	17	80	42	35
9	19	54	80	54	40
9	20	22	81	3	40
9	20	59	81	16	50

Barometer 29.3; thermometer 60°. Index error — 15″.

SAULT, JULY 1. (C. 1122.)

h.	min.	sec.	Deg.	min.	sec.
5	22	43	64	56	5
5	23	27	64	40	5
5	24	14	64	25	5
5	24	55	64	10	55
5	25	27	63	59	55
5	26	13	63	54	30

SAULT STE. MARIE, BARRACKS, JULY 3, 1848.

TIME OBSERVATIONS.

h.	min.	sec.	Deg.	min.	sec.
9	11	42.5	77	45	5
9	12	37	78	4	30
9	14	26	78	41	00
9	15	11	78	58	35
9	16	15.5	79	21	00
9	17	5.5	79	35	00
9	17	51	79	52	30
9	18	32	80	5	30
9	19	14	80	18	55
9	19	49	80	30	35
9	20	35	80	46	25
9	21	8	80	57	55
9	33	17.5	85	8	40
9	39	46.5	87	29	00
9	42	21.5	88	8	24
9	44	23	88	54	

Barometer 29; thermometer 60°.

BARRACKS, SAULT, JULY 3, 1848, P. M.

TIME OBSERVATIONS.—(CHRONOMETER 1122 and WHITNEY'S SEXTANT.)

h.	min.	sec.	Deg.	min.	sec.
5	8	58	69	35	50
5	9	51	69	17	55
5	10	43.5	63	59	55
5	11	15	68	50	00
5	11	48	68	39	20
5	12	30	68	23	30
5	18	17	66	21	50
5	19	26.5	65	58	45
5	20	12	65	42	50
5	21	57.5	65	5	45
5	22	36.5	64	53	10
5	23	36.5	64	52	15
5	26	2.5	63	44	10
5	26	31	63	34	55
5	27	00	63	25	00
5	27	45.5	63	9	30
5	28	11	63	00	40
5	28	53	62	47	30

BARRACKS, SAULT, JULY 5, A. M.

TIME OBSERVATIONS.

h.	min.	sec.	Deg.	min.	sec.
9	32	46.5	84	31	00
9	33	19	84	41	15
9	34	57	85	14	35
9	35	31.5	85	27	30
9	36	11	85	40	40
9	36	36.5	85	48	50
9	37	10	85	58	40
9	37	54	86	13	45
9	38	24	86	23	15
9	38	52.5	86	33	5
9	39	19.5	86	42	30
9	39	48.5	86	52	10

BARRACKS, SAULT, JULY 4, 1848. (C. 1122.)

TIME OBSERVATIONS.

h.	min.	sec.	Deg.	min.	sec.
9	32	58	84	48	15
9	33	38	85	1	15
9	34	8	85	11	00
9	34	51.5	85	26	15
9	35	28	85	37	55
9	36	5	85	50	15
9	37	9.5	86	12	05
9	37	43	86	22	35
9	38	26	86	37	35
9	39	20.5	86	55	35
9	40	1.5	87	9	35
9	40	42	87	22	30

Barometer 29.25; thermometer 60°. Index error — 20″.

JULY 4, 1848, P. M. (C. 1122.)

TIME OBSERVATIONS.

h.	min.	sec.	Deg.	min.	sec.
5	37	37	59	42	25
5	38	51.5	59	19	10
5	39	35.5	59	02	30
5	40	15	58	49	15
5	40	55	58	35	35
5	41	27	58	23	20
5	42	00	58	13	10
5	42	35.5	58	2	30
5	43	58.5	57	49	60
5	43	53.5	57	35	05
5	45	10	57	09	40
5	45	39	56	58	05
5	46	21	56	44	35

Barometer 29.3; thermometer 75°. Index error — 15″.

BARRACKS, SAULT, JULY 5, P. M.

TIME OBSERVATIONS.

h.	min.	sec.	Deg.	min.	sec.
5	7	11.5	70	8	00
5	7	49	69	54	10
5	8	24	69	42	20
5	9	26	69	20	35
5	10	42.5	68	55	40
5	11	17.5	68	42	55
5	11	57.5	68	28	45
5	12	35.5	68	17	50
5	13	20	68	00	55
5	14	9.5	67	43	35
5	14	53.5	67	30	20
5	15	22.5	67	19	10

Index error — 30″.

SAULT, JULY 6.

TIME OBSERVATIONS.

h.	min.	sec.	Deg.	min.	sec.
9	34	18	84	48	30
9	35	2.5	85	3	10
9	35	39	85	14	55
9	36	26.5	85	31	45
9	36	59	85	44	15
9	37	31.5	85	55	00
9	38	A	86	5	35
9	38	47.5	86	19	15
9	39	23.5	86	32	30
9	39	55	86	41	40
9	40	33.5	86	55	5
9	41	13	87	8	30
9	42	13	88	30	55
9	43	11	88	50	30
9	44	16.5	89	12	10
9	45	58.5	89	45	00

Barometer 29.160; thermometer 70°; index error — 30″.

FORT WILKINS, COPPER HARBOR, JULY 11, 1848. (C. 1122.)

TIME OBSERVATIONS.

h.	min.	sec.		Deg.	min.	sec.
6	17	58.5		50	15	30
6	19	1		49	57	35
6	19	50.5		49	38	5
6	20	28.5		49	25	55
6	21	15		49	9	15
6	21	51		48	57	10
6	22	22.5		48	46	50
6	23	3.5		48	35	10
6	23	31.5		48	23	45
6	24	17		48	9	40
6	24	54		47	58	5
6	25	29		47	45	50
6	26	10		47	33	35
6	27	37		47	00	55

Barometer 29.5; thermometer 70°; index error — 27.5″.

FORT WILKINS, JULY 12, 1848, A. M. (C. 1122.)

TIME OBSERVATIONS.

h.	min.	sec.		Deg.	min.	sec.
9	47	15		82	40	15
9	47	51.5		82	51	55
9	48	27.5		83	4	50
9	48	54.5		83	14	00
9	49	27.5		83	23	30
9	49	56		83	33	25
9	50	32.5		83	46	0
9	51	4		83	55	5
9	51	39		84	7	35
9	52	11		84	17	25
9	52	36.5		84	25	20
9	53	17.5		84	38	10

Barometer 29.5; thermometer 35°; index error — 20″.

FORT WILKINS, JULY 13. (C. 1122.)

TIME OBSERVATIONS.

h.	min.	sec.		Deg.	min.	sec.
9	27	37.2	0	75	54	5
9	28	37.5		76	14	15
9	29	8.5		76	25	55
9	30	2		76	43	35
9	30	49.5		76	59	45
9	31	29		77	13	40
9	32	48.5	0	78	41	55
9	34	30.5		79	15	30
9	35	1.5		79	25	5
9	35	31.5		79	35	45
9	36	19		79	52	25
9	36	56.5		80	4	10

Barometer 29.5; thermometer 65°.

COPPER HARBOR, JULY 13.

MERIDIAN ALTITUDES.

h.	min.	sec.	Deg.	min.	sec.
12	55	57	127	33	35
12	57	26.5	127	38	20
12	58	12.5	127	41	40
12	59	9	127	43	20
12	59	53.2	127	45	40
1	0	39	127	47	55
1	1	34.5	127	50	35
1	2	26	127	52	15
1	3	38.5	127	55	30
1	4	36	127	56	10
1	5	50	127	59	40
1	6	59.5	128	00	30
1	9	55	128	2	55
1	11	29.5	128	5	30
1	13	18.5	128	7	5
1	14	37.5	128	7	10
1	17	18.5	128	4	40
1	18	26.5	128	3	20
1	23	23.5	127	39	00
1	24	27	127	37	25
1	25	19.5	127	35	00
1	26	9.5	127	33	45

COPPER HARBOR, JULY 14, 1848. (C. 1222.)

h.	min.	sec.	Deg.	min.	sec.
4	49	31.5	79	30	35
4	50	30.5	79	11	10
4	51	9	78	59	40
4	51	41.5	78	48	50
4	52	35	78	30	00
4	53	4.5	78	21	40
4	53	6	78	7	20
4	54	31.5	77	53	40
4	55	16.5	77	38	45
4	56	9	77	21	20
4	57	9	77	00	00
4	57	56.5	76	45	10

Barometer 29.5; thermometer 67°.

JULY 14, 1848, P. M.

TIME OBSERVATIONS—(DR. JACKSON'S SEXTANT.)

h.	min.	sec.	Deg.	min.	sec.
5	5	38.5	74	7	45
5	7	53.5	73	23	15
5	9	4.5	72	59	00

Index error 1′ 35″.

FORT WILKINS, JULY 14, 1848, A. M. (C. 1122.)

TIME OBSERVATIONS.

h.	min.	sec.	Deg.	min.	sec.
9	46	39	81	57	5
9	47	20.5	82	10	15
9	47	46	82	18	45
9	48	23	82	31	10
9	49	2.3	82	44	55
9	49	37	82	57	20
9	50	10	83	6	35
9	50	41.5	83	16	55
9	51	44.5	83	37	
9	52	30	83	41	55
9	53	2 5	84	2	00
9	53	38.5	84	14	50

Barometer 29.5; thermometer 65°. Index error — 12'.5.

JULY 14.

MERIDIAN ALTITUDES.

h.	min.	sec.	Deg.	min.	sec.
1	2	18	127	33	55
1	3	17.5	127	37	5
1	4	40.5	127	38	30
1	5	58.5	127	39	50
1	6	57	127	43	20
1	8	17.5	127	45	40
1	9	55	127	46	30
1	11	69.5	127	48	15
1	15	00	127	46	50
1	16	57.5	127	46	5
1	17	48	127	45	00
1	19	29	127	43	20
1	20	57.5	127	42	50
1	21	49	127	41	45
1	22	22.5	127	40	35

FORT WILKINS, JULY 13, 1848, P. M.

TIME OBSERVATIONS.

	h.	min.	sec.	Deg.	min.	sec.
1.	4	42	59	81	51	00
2.	4	45	33.5	81	00	15
3.	4	47	13.5	80	26	45
4.	4	48	17.5	80	4	15
5.	4	49	38.5	79	37	30
6.	4	50	59	79	11	30
7.	4	53	15.5	78	29	35
8.	4	53	59	78	15	25
9.	4	54	33.5	78	4	00
10.	4	55	45.5	77	40	30
11.	4	56	30.5	77	24	30
12.	4	57	10.5	77	11	10
13.	4	57	41	77	1	30
14.	4	58	14.5	76	51	35
15.	4	58	50.5	76	39	15
16.	4	59	25	76	28	35
17.	5	00	1.5	76	16	25
18.	5	00	50	75	59	20

Barometer 29.4; thermometer 70°. Index error — 2′ 30″.

FORT HILL, JULY 15, 1848, A. M. (C. 1122)

TIME OBSERVATIONS.

h.	min.	sec.	Deg.	min.	sec.
9	18	43	82	20	50
9	49	16.3	82	32	5
9	50	4	82	47	35
9	50	44.5	82	59	50
9	51	41.5	83	19	35
9	52	45	83	40	00
9	53	56.5	84	2	25
9	54	39	84	16	20
9	55	13	84	27	50
9	55	46.5	84	38	30
9	56	18.2	84	49	00
9	56	52.2	84	59	50

Barometer 29.40; thermometer 60°. Index error + 10″.

FORT WILKINS, JULY 15. (C. 1122.)

MERIDIAN ALTITUDES.

h.	min.	sec.	Deg.	min.	sec.
1	3	59	127	17	5
1	5	11.5	127	19	30
1	6	5	127	20	30
1	7	40	127	24	25
1	9	40.5	127	26	25
1	11	38.5	127	28	45
1	14	2.5	127	28	00
1	18	3.5	127	27	10
1	18	59	127	25	50
1	20	35	127	24	10
1	21	30.5	127	23	40
1	22	27	127	22	00
1	23	11	127	20	40
1	24	30	127	18	45
1	25	14.5	127	17	00
1	25	57	127	15	40

FORT WILKINS, JULY 15, P. M.

TIME OBSERVATIONS.

h.	min.	sec.	Deg.	min.	sec.
5	6	36	73	39	40
5	7	28.5	73	23	45
5	8	10.5	73	9	50
5	8	48	72	58	00
5	9	43	72	40	55
5	10	22	72	25	30
5	12	43	71	37	5
5	13	35	71	20	50
5	14	12.5	71	9	00
5	14	55.5	70	54	10
5	15	38.5	70	38	20
5	16	16.5	70	25	50
5	17	12.5	70	6	50
5	18	9.5	69	48	20
5	19	10	69	28	55
5	19	55	69	11	20
5	21	6.2	68	49	25
5	21	47.5	68	35	10

Barometer 29.50; thermometer 70°. Index error + 15″.

FORT WILKINS, JULY 16, 1848, A. M. (C. 1122.)

TIME OBSERVATIONS.

h.	min.	sec.		Deg.	min.	sec.
9	53	59		83	46	10
9	55	7.5		84	9	30
9	55	38.5		84	19	5
9	56	16.5		84	31	00
9	57	19		84	51	35
9	58	13.5		85	9	40
9	58	47.5		85	20	45
9	59	26.5		85	32	55
10	00	1.5		85	44	45
10	00	47.5		85	59	10
10	1	19		86	10	40
10	2	2		86	23	20

Index error + 5″.

FORT WILKINS, JULY 18, P. M. (C. 1122.)

TIME OBSERVATIONS.

h.	min.	sec.		Deg.	min.	sec.
4	37	53	0	83	36	5
4	38	47		83	28	40
4	39	32		83	4	15
4	40	36.5		82	43	00
4	41	18.5		82	29	10
4	42	3		82	15	10
4	42	47.5		82	00	35
4	43	34		81	44	55
4	44	25		81	28	5
4	44	59.5		81	17	20
4	46	2		80	57	00
4	46	51		80	40	05
4	50	28.5		79	26	45
4	51	37		79	4	15
4	52	51.5		78	39	55
4	53	51		78	20	30
4	54	44		78	1	50
4	55	19		77	50	30

Index error by Dr. Jackson's sextant 2′ 12.5″.

FORT WILKINS, JULY 19, A. M. (C. 1122.)

h.	min.	sec.	Deg.	min.	sec.
10	5	38	86	41	20
10	6	42.5	87	2	30
10	8	12.5	87	30	10
10	8	51.5	87	44	15
10	9	36.5	87	57	40
10	10	34	88	17	15
10	11	11	88	27	55
10	11	51.5	88	42	35
10	12	27	88	50	30
10	12	57.5	89	2	30
10	13	25	89	12	00
10	14	3.5	89	22	10
10	15	3	89	40	5
10	15	30	89	49	40
10	16	12	90	1	50

Barometer 29.3; thermometer 72°; index error 5″.

PORTAGE, JULY 22, 1848, A. M.

TIME OBSERVATIONS.

h.	min.	sec.	Deg.	min.	sec.
9	50	38	80	6	15
9	51	32.5	80	24	35
9	52	46	80	40	15
9	53	24	81	2	15
9	54	6.2	81	16	15
9	55	11.2	81	36	40
9	56	14	81	56	35
9	56	54.5	82	10	45
9	57	45	82	25	20
9	58	15.5	82	35	20
9	58	56	82	48	30
9	59	39	83	3	45

Barometer 29.53; thermometer 55°; index error + 7.5″.

ONTONAGON RIVER, JULY 25, 1848, A. M.

TIME OBSERVATIONS.

h.	min.	sec.	Deg.	min.	sec.
8	57	13.5	60	25	20
8	58	14.5	60	46	50
8	59	2	61	3	25
8	59	53.5	61	21	15
9	00	39	61	35	55
9	1	34.5	61	55	35
9	2	22.5	62	11	15
9	3	4	62	24	56
9	3	46.5	62	40	50
9	4	35 5	62	57	50
9	5	36.2	63	18	50
9	6	7	63	27	40
9	6	36 5	63	38	5
9	7	13.5	63	52	00
9	7	57	64	5	15
9	8	35.4	64	18	30
9	9	21	64	33	30
9	9	56	64	46	30

Barometer 29.635; thermometer 59°. Index error — 5″.

PORTAGE, JULY 22, A. M.

h.	min.	sec.	Deg.	min.	sec.
10	11	58.5	87	2	35
10	12	52.5	87	20	15
10	13	30.5	87	32	10
10	14	12	87	45	20
10	14	41.5	87	54	55
10	15	10	88	2	20

ONTONAGON RIVER, JULY 24, 1848, P. M.

TIME OBSERVATIONS.

h.	min.	sec.	Deg.	min.	sec.
4	7	47	92	48	10
4	8	31.5	92	33	55
4	9	17 5	92	19	55
4	9	59.5	92	8	30
4	10	46	91	53	45
4	15	48.5	90	17	10
4	16	29.5	90	4	45
4	17	22	89	49	40
4	21	33.5	88	27	35
4	22	43.5	88	5	5
4	23	48.5	87	43	55
4	24	33	87	29	55
4	25	34	87	12	30

Index error 5″.

PRESQ'ISLE RIVER, JULY 27, 1848.

LATITUDE OBSERVATIONS.

h.	min.	sec.	Deg.	min.	sec.
1	6	32 5	123	49	20
1	7	38.5	123	53	40
1	8	38	123	55	25
1	9	19	123	59	40
1	10	25 5	124	4	00
1	11	45.5	124	5	30
1	13	26.5	124	7	20
1	14	4	124	8	20
1	14	37	124	9	35
1	15	22	124	10	30
1	16	21	124	12	35
1	17	6	124	13	50
1	17	54	124	14	30
1	18	35	124	15	00
1	20	10.5	124	15	50
1	22	12	124	15	30
1	24	00	124	15	20
1	26	47	124	14	10
1	28	31	124	13	15
1	29	25	124	12	15

Barometer 29.35; thermometer 75°. Index error + 5″.

MOUTH OF CARP RIVER, JULY 26, 1848, P. M.

TIME OBSERVATIONS.

h.	min.	sec.	Deg.	min.	sec.
4	26	56	86	54	15
4	28	3.5	86	33	10
4	29	9	86	12	40
4	30	28	85	52	10
4	31	6	85	36	55
4	31	35	85	24	35
4	33	28	84	48	30
4	33	56.5	84	39	15
4	34	48.5	84	25	30
4	35	47	84	7	40
4	36	13.5	83	55	30
4	36	47	83	43	45
4	37	13	83	32	25
4	37	53	83	22	15
4	38	37	83	7	45
4	39	9	82	58	00
4	40	00.5	82	45	40

Index error 10″.

ONTONAGON RIVER, AUGUST 18.

h.	min.	sec.	Deg.	min.	sec.
1	1	31	111	11	50
1	2	35.5	111	14	50
1	3	48.5	111	18	5
1	5	28	111	21	20
1	6	16.5	111	23	30
1	7	10.2	111	25	10
1	8	00	111	26	30
1	11	52.5	111	31	40
1	12	39	111	32	50
1	14	23	111	33	50
1	15	6	111	34	20
1	15	43	111	35	30
1	17	3	111	36	50
1	17	49	111	37	30
1	20	41.2	111	36	20
1	21	42.5	111	36	3.5
1	22	46	111	34	10
1	24	17	111	32	20
1	25	13	111	31	00
1	26	3.2	111	30	50
1	26	36	111	29	55
1	27	56.5	111	28	10
1	28	40.5	111	27	30
1	29	37	111	26	00

Barometer 29.500; thermometer 62°.

ONTONAGON RIVER, AUGUST 18.

h.	min.	sec.	Deg.	min.	sec.
1	30	27	110	44	20
1	30	57.5	110	43	00
1	31	22.5	110	42	20
1	31	58.5	110	41	00
1	32	28.5	110	40	5

Barometer 29.45; thermometer 75°. Index error + 10″.

ONTONAGON RIVER, AUGUST 19.

MERIDIAN ALTITUDES.

h.	min.	sec.	Deg.	min.	sec.
12	43	16.5	109	21	10
12	43	56.5	109	24	20
12	44	44	109	29	5
1	0	56.5	110	31	35
1	1	37	110	33	40
1	2	15.5	110	35	30
1	3	55	110	39	25
1	4	28	110	40	25
1	5	8	110	41	40
1	5	44.5	110	43	00
1	6	18	110	44	15
1	6	54.5	110	45	10
1	7	34	110	46	10
1	8	29	110	47	30
1	10	23.5	110	50	30
1	11	10	110	51	00
1	11	43	110	51	55
1	14	29.5	110	54	5
1	16	1.5	110	54	30
1	17	3.5	110	55	25
1	19	9.5	110	55	00
1	21	16.5	110	54	20
1	22	19	110	53	40
1	23	19.5	110	52	5
1	24	14	110	51	00
1	25	22	110	50	10
1	25	59.5	110	49	30
1	26	34	110	48	55
1	27	27.5	110	47	00
1	28	8	110	47	20
1	28	46.5	110	46	20
1	29	23.5	110	44	00

ONTONAGON RIVER, AUGUST 19, 1848, A. M.

TIME OBSERVATIONS.

h.	min.	sec.	Deg.	min.	sec.
9	12	48.2	56	42	25
9	13	42.3	57	00	30
9	15	12.5	57	30	55
9	15	47.5	57	41	45
9	16	26.5	57	54	30
9	17	13.5	58	10	30
9	18	25	58	34	30
9	18	58 5	58	46	5
9	19	33.5	58	57	10
9	20	2	59	7	20
9	20	32.6	59	16	55
9	21	13	59	29	50

Barometer 29.45; thermometer 68°. Index error + 5″.

ONTONAGON RIVER, AUGUST 18, 1848.

TIME OBSERVATIONS.

h.	min.	sec.	Deg.	min.	sec.
9	31	28.2	63	16	5
9	32	25.2	64	35	10
9	33	42	64	00	5
9	34	28.5	64	15	10
9	35	23	64	33	20
9	36	37	64	57	30
9	38	30.5	65	34	30
9	39	15.2	65	48	50
9	39	57.6	66	2	50
9	40	52	66	20	30
9	41	40	66	36	15
9	42	28	66	51	5
10	0	50.5	72	44	5
10	1	38.5	72	59	5
10	2	12.7	73	9	35
10	2	50	73	21	10
10	3	30	73	34	20
10	4	17	73	49	55
10	4	59.2	74	3	40
10	6	8	74	23	45
10	6	55.5	74	38	20
10	7	59.5	74	59	00
10	8	46	75	13	00
10	9	17.3	75	22	5

Barometer 29.55; thermometer 64°.

IRON RIVER, AUGUST 12.

h.	min.	sec.	Deg.	min.	sec.
10	13	1.5	78	48	00
10	14	19.5	79	12	30
10	14	47	79	21	20
10	15	35.5	79	38	30
10	16	16.6	79	49	40
10	17	13.5	80	8	35

Barometer 29.5; thermometer 70°. Index error — 10″.

(Cloudy.)

IRON RIVER, AUGUST 12.

h.	min.	sec.	Deg.	min.	sec.
9	59	45	74	34	40
10	2	39	75	30	5
10	3	16	75	42	5
10	4	0.5	75	56	30
10	4	50.5	76	12	40
10	5	18.5	76	22	10

Barometer 29.55; thermometer 61°.

CARP RIVER, AUGUST 5, 1848, A. M.

TIME OBSERVATIONS.

h.	min.	sec.	Deg.	min.	sec.
9	9	31.5	60	9	25
9	10	25.5	60	28	10
9	11	17.5	60	46	10
9	11	59.2	61	00	00
9	12	25	61	8	10
9	33	46.2	68	19	10
9	34	33.5	68	35	00
9	35	00	68	43	25
9	35	36	68	55	25
9	36	8	69	6	35
9	36	32 5	69	14	50

Barometer, 29.6; thermometer, 57°. Index error + 5′.

(*Cloudy.*)

IRON RIVER, AUGUST 12, 1848.

LATITUDE OBSERVATIONS.

h.	min.	sec.	Deg.	min.	sec.
1	10	46.5	115	19	10
1	13	10	115	21	40
1	14	15.5	115	23	15
1	15	39	115	24	40
1	16	48	115	25	45
1	18	27 2	115	25	55
1	21	29.7	115	26	10
1	22	34	115	26	00
1	23	24	115	25	20
1	25	13	115	24	40
1	25	57	115	24	00
1	27	11.5	115	23	5
1	27	50.2	115	22	20
1	28	39	115	21	40
1	29	23.5	115	20	35

CARP RIVER, AUGUST 4, 1848, P. M.

TIME OBSERVATIONS.

h.	min.	sec.	Deg.	min.	sec.
4	50	0.5	76	5	55
4	50	45	75	52	30
4	51	20	75	39	50
4	51	53	75	29	10
4	52	13 5	75	17	00
4	53	13	75	2	20
4	54	49 5	74	32	00
4	55	22.5	74	19	40
4	55	50.6	74	10	20
4	56	22.8	74	10	00
4	57	28.5	73	37	45
4	59	14 5	73	03	55
5	15	24.5	67	43	20
5	16	53	67	13	00
5	17	25.5	66	59	45
5	18	1.6	66	48	40
5	18	46.5	66	32	50
5	19	49	66	12	10
5	20	33.2	65	57	00
5	21	7	65	45	30
5	21	34.5	65	37	40
5	22	9	65	25	25
5	22	36.5	65	15	35

Index error — 5″.

MOUTH PRESQ'ISLE RIVER, JULY 27, 1848, P. M.

TIME OBSERVATIONS.

h.	min.	sec.	D-g.	min.	sec.
4	30	12.5	85	38	40
4	31	5.5	85	22	45
4	31	49.2	85	9	30
4	32	18	84	58	35
4	33	41.5	84	32	25
4	34	11	84	22	55
4	34	39.5	84	13	40
4	35	20.5	84	1	10
4	35	43	83	53	30
4	36	17	83	43	00
4	36	39.5	83	36	15
4	37	8	83	27	50
4	37	53.2	83	13	45
		Natural horizon.			
4	39	21	41	29	30
4	40	3.5	41	19	30
4	40	53	41	9	35

CARP RIVER, AUGUST 5, 1848, A. M.

TIME OBSERVATIONS.

h.	min.	sec.	Deg.	min.	sec.
9	9	31.5	60	9	25
9	10	25.5	60	28	10
9	11	17.5	60	46	10
9	11	59.2	61	00	00
9	12	25	61	8	10
9	33	46.2	68	19	10
9	34	33.5	68	35	00
9	35	00	68	43	25
9	35	36	68	55	25
9	36	8	69	6	35
9	36	32 5	69	14	50

Barometer, 29.6; thermometer, 57°. Index error + 5′.

(*Cloudy.*)

IRON RIVER, AUGUST 12, 1848.

LATITUDE OBSERVATIONS.

h.	min.	sec.	Deg.	min.	sec.
1	10	46.5	115	19	10
1	13	10	115	21	40
1	14	15.5	115	23	15
1	15	39	115	24	40
1	16	48	115	25	45
1	18	27 2	115	25	55
1	21	29.7	115	26	10
1	22	34	115	26	00
1	23	24	115	25	20
1	25	13	115	24	40
1	25	57	115	24	00
1	27	11.5	115	23	5
1	27	50.2	115	22	20
1	28	39	115	21	40
1	29	23.5	115	20	35

CARP RIVER, AUGUST 4, 1848, P. M.

TIME OBSERVATIONS.

h.	min.	sec.	Deg.	min.	sec.
4	50	0.5	76	5	55
4	50	45	75	52	30
4	51	20	75	39	50
4	51	53	75	29	10
4	52	13 5	75	17	00
4	53	13	75	2	20
4	54	49 5	74	32	00
4	55	22.5	74	19	40
4	55	50.6	74	10	20
4	56	22.8	74	10	00
4	57	28.5	73	37	45
4	59	14 5	73	03	55
5	15	24.5	67	43	20
5	16	53	67	13	00
5	17	25.5	66	59	45
5	18	1.6	66	48	40
5	18	46.5	66	32	50
5	19	49	66	12	10
5	20	33.2	65	57	00
5	21	7	65	45	30
5	21	34.5	65	37	40
5	22	9	65	25	25
5	22	36.5	65	15	35

Index error — 5″.

MOUTH PRESQ'ISLE RIVER, JULY 27, 1848, P. M.

TIME OBSERVATIONS.

h.	min.	sec.	D·g.	min.	sec.
4	30	12.5	85	38	40
4	31	5.5	85	22	45
4	31	49.2	85	9	30
4	32	18	84	58	35
4	33	41.5	84	32	25
4	34	11	84	22	55
4	34	39.5	84	13	40
4	35	20.5	84	1	10
4	35	43	83	53	30
4	36	17	83	43	00
4	36	39.5	83	36	15
4	37	8	83	27	50
4	37	53.2	83	13	45
		Natural horizon.			
4	39	21	41	29	30
4	40	3.5	41	19	30
4	40	53	41	9	35

MONTREAL RIVER, AUGUST 1, 1848, A. M.

TIME OBSERVATIONS.

h.	min.	sec.	Deg.	min.	sec
9	29	36.5	67	43	2
9	30	29	68	1	2
9	31	8.5	68	15	3
9	31	49.5	68	30	0
9	32	16	68	37	5
9	32	55	68	50	1
9	33	44	69	7	1
9	34	28	69	22	1
9	34	52.2	69	29	1
9	35	30.8	69	43	1
9	36	9	69	55	1
9	36	47.5	70	9	3
9	38	5 5	70	34	4
9	39	19.5	71	1	1
9	39	56	71	12	2
9	40	22.5	71	20	5
9	40	45	71	28	15
9	41	27.5	71	42	30
9	41	55.5	71	51	40
9	42	24	72	2	00
9	43	9	72	16	5

MONTREAL RIVER, JULY 31, 1848.

LATITUDE OBSERVATIONS.

h.	min.	sec.	Deg.	min.	sec.
1	2	15 5	121	50	40
1	4	3.5	121	57	20
1	5	15	122	0	0
1	6	12.5	122	5	0
1	6	43.5	122	6	40
1	7	40.8	122	10	5
1	8	13	122	11	45
1	9	54.5	122	17	20
1	11	24	122	20	50
1	13	37.5	122	25	35
1	16	10	122	31	30
1	17	16	122	32	40
1	18	23.5	122	34	55
1	20	16.5	122	39	0
1	22	9.3	122	41	10
1	23	53.5	122	40	40
1	24	36	122	39	55
1	25	33	122	38	30
1	27	33.5	122	37	25
1	29	1	122	36	55
1	31	15	122	35	40
1	32	26	122	33	50
1	32	59.5	122	32	15
1	33	40	122	30	50
1	34	58.5	122	29	40
1	35	36.8	122	28	20
1	36	1.2	122	27	20

Barometer 29.3; thermometer 70°.

MOUTH OF MONTREAL RIVER, AUGUST 1, 1848.

LATITUDE OBSERVATIONS.

h.	min.	sec.	Deg.	min.	sec.
1	10	50.5	121	50	0
1	11	52 5	121	52	10
1	12	28	121	53	55
1	13	34	121	55	10
1	14	34	121	58	30
1	15	25	121	59	30
1	16	14	122	0	10
1	18	5.5	122	2	30
1	18	44 5	122	3	30
1	19	20	122	4	5
1	19	59.5	122	5	0
1	20	39.5	122	5	30
1	21	30.5	122	5	55
1	22	32.5	122	6	10
1	24	21	122	6	45
1	27	56	122	6	30
1	28	35 5	122	6	15
1	29	32.5	122	5	30
1	30	24	122	5	10
1	31	7	122	4	40
1	31	46	122	3	40
1	32	40.5	122	2	30
1	33	21.5	122	1	20
1	34	0.5	122	0	20
1	34	37.5	121	59	40
1	35	4.5	121	59	0
1	35	37	121	58	10
1	36	2.5	121	57	25
1	36	38	121	56	20
1	37	6.5	121	55	0

Barometer 29.3; thermometer 77°.

MONTREAL RIVER, AUGUST 2, 1848.

TIME OBSERVATIONS.

h.	min.	sec.	Deg.	min.	sec.
9	24	22.2	65	35	00
9	24	58.5	65	47	5
9	25	39	66	00	50
9	26	19.5	66	15	15
9	27	1	66	28	15
9	27	27	66	37	5
9	28	4.2	66	50	15
9	28	46	67	3	55
9	29	16.5	67	14	10
9	30	13.5	67	33	30
9	30	50.5	67	46	15
9	31	23 5	67	57	00
9	32	2.5	68	9	55
9	32	38	68	22	55
9	33	14	68	34	20
9	33	38.5	68	43	10
9	34	16	68	55	30
9	34	46	69	5	30

Index error + 5″.

COPPER HARBOR, FORT WILKINS, AUGUST 29, A. M.

TIME OBSERVATIONS.

h.	min.	sec.	Deg.	min.	sec.
9	38	19.6	62	6	55
9	38	59	62	19	00
9	39	35.5	62	30	00
9	40	12	62	41	40
9	41	26.5	63	4	20
9	42	9.7	63	17	50
9	42	36.5	63	27	10
9	43	6	63	35	10
9	43	39.8	63	45	35
9	44	24.5	63	59	10

Barometer 29.442; thermometer 68°.

FORT WILKINS, AUGUST 29, 1848.

MERIDIAN ALTITUDES.

h.	min.	sec.	Deg.	min.	sec.
1	5	39.5	102	50	40
1	6	18.2	102	52	00
1	7	40	102	51	30
1	8	27.2	102	51	50
1	9	20	102	51	45
1	9	59.5	102	51	50
1	10	51	102	51	40
1	11	33	102	51	35
1	12	39.2	102	51	5
1	13	50.5	102	50	30
1	14	38	102	49	55
1	15	58.2	102	49	10
1	16	34.7	102	49	10
1	17	24	102	48	35
1	18	16	102	47	20
1	19	.5	102	46	00
1	19	35	102	45	25
1	00	00	102	00	18

Barometer 29.24; thermometer 79°.

FIELD-NOTES OF DR. W. GIBBS, SUB-AGENT, IN 1848.

Douglass Houghton location.

Township 37, section corner $\frac{1}{11}|\frac{1}{14}$, cabins near the section corner. September 15, despatched Dickenson to explore the line south of the corner, followed the west line of McIntyre; on leaving the corner, passed, first, over a low ridge of trap, (barometer,) then a swamp about 100 yards in width, then a higher ridge of trap with a steep ascent, and covered with a thick growth of young maple; (barometer.) From the top of this ridge the ground descends gently for about three-quarters of the remaining distance to the first section corner west of the cabins, viz: $\frac{1}{13}|\frac{1}{14}$; trap found in place one-eighth of a mile east of this corner; timber maple, with some hemlock; ground between the first corner west and the river very uneven; knobby ridges, in which no rock could be found in place, but which appeared to be trap, (doubtful;) bed of stream mostly trap fragments, some sandstone; crossed the river one-half mile beyond $\frac{1}{13}|\frac{1}{14}$; country even, rather wet; chiefly hemlock, some maple; banks of the river a red mixture of clay and sand; crossed another branch of the river (Fire Steel) three times, about half way between $\frac{1}{13}|\frac{1}{14}$ and $\frac{1}{13}|\frac{1}{15}$; banks of the river the same; character of country much the same, tolerably even; timber hemlock, maple, fir, &c.; much ground hemlock; at section corner $\frac{1}{13}|\frac{1}{15}$ ground even; timber the same; same character of ground and timber continues west and south of this corner; trail runs northeast and southwest. Returning, crossed northeast to corner $\frac{9}{17}|\frac{1}{17}$, then east to corner $\frac{9}{16}|\frac{1}{17}$, then south to the cabins; no rock whatever in place; the pebbles and pieces of stone found in the roots of trees, &c., were sandstone; maple predominates, then hemlock; ground even.

September 18.—Sent McIntyre back on the west line to explore again the first corner west of the cabins, near which I place the limits of the trap; started on the east line with Dickenson; line very difficult to trace; about one-fourth mile from cabins, crossed a high trap range running nearly north and south; highest point a few hundred yards south of the line; (barometer;) sandstone pebbles frequent in the soil of the ridge; point measured believed to be the southeast extremity of the ridge; fine view to the east. Soon after leaving the trap range, passed a brook, and then ascended a ridge of conglomerate; conglomerate observed in place; (barometer;) then crossed the river; then another ridge of conglomerate; no traces of trap found 1¼ mile east of cabins; soil and timber indicated sandstone or conglomerate. *Conclusions:* that the limit of the trap to the west of section corner $\frac{1}{11}|\frac{1}{14}$ lies between 1 and 1½ mile from the same; that the line of junction of the trap and conglomerate, mentioned above, is accurately laid down on the section maps; but the limits of the trap and sandstone on Hubbard's map are inaccurate.—(Refer to notes of McIntyre and Dickenson.)

September 20.—Left for the southwest corner of the township (37) one-sixteenth mile from the cabins, (southwest;) crossed a ridge or knoll of trap not laid down on the township plats; (barometer;) country between this and the first corner southwest, or $\frac{1}{16}|\frac{1}{14}$, undulating, well watered, and covered with a fine maple growth; a few hemlocks; same character continues to the next corner, though on the whole there is a gentle descent towards this last, $\frac{33}{34}|\frac{1}{35}$, where the ground rises into steep knolls

trap, one of which, lying a little to the north of the section corner, ...d laid down on the township plats, was measured. After passing this ...rner to the southwest, the country is nearly level, and the maple much ...ixed with hemlock, ironwood, fir, &c. At the southwest corner of the ...wnship, the land is low and swampy.

September 21—(Camp southwest corner of 37.)—Sent Dickenson east, ...cIntyre south, and followed the north line myself. Land for the first ...lf mile north level or gently undulating near the quarter-post; a ...all clearing here, but no mine; fine maple growth. Immediately after ...ssing the quarter-post the land begins to rise. Quarter of a mile be...nd the quarter-post passed a high ridge of trap, from the top of which ...ere is a fine view to the south. From this to the first corner north ...|$\frac{33}{33}$. the land is high, undulating. A stream runs west to east just before ...aching the corner. Shortly after passing the first corner north, a high ...dge of trap east and west is crossed; then the ground descends till near ...e quarter-post, where a stream passes. A small clearing is passed, with small hut and potato-patch; a well-blazed east and west trail leads to ...e same. Another ridge of trap follows, somewhat lower than the pre...ding; after which the land descends at an angle of 30° to the quarter-...st. Leaving this we have first high undulating ground, then a stream ...nning southwest to northeast; sandy bottom; sandstone pebbles pre...minating. After this the land is low, undulating. Between this stream ...d the second section, corner north of camp, counted six low ridges ...early east and west; timber, maple and hemlock. Near the second cor...er, on $\frac{1}{3}\frac{2}{3}$, the ground becomes more level, and soft woods predominate. ...t the quarter-post between first and second corner north of camp is a ...cation post, marked "northwest corner of P. Thomas's location." Re...rned to camp. I place the limit of the trap on this line at one mile and ...ree-quarters north of the southwest corner of the township. McIntyre ...d Dickenson could obtain no *certain* information as to the limits on the ...uth and east lines.

September 21, *p. m.*—Took the west line from camp; land for the first ...lf mile level, then gently rising, and timber improving; fine maple ...nd continues all the way to the third corner, or $\frac{3}{4}\frac{4}{3}$ of township 38; trap ...ck frequently exposed in place.

September 22.—Camp near $\frac{4}{3}\frac{4}{3}$. Sent Dickenson west, and took the ...rth line with McIntyre. 1, an open hemlock wood; then a stream, ...ith large angular fragments of trap; further on, soft woods increasing; ...ssed the same brook again; sandstone pebbles and gravel in bed. ...bout $\frac{1}{16}$ of a mile from the first corner to southeast found trap in ...ace; the whole ridge is trap. Followed the east and west line from ...rner $\frac{2}{3}\frac{9}{4}|\frac{3}{3}\frac{3}{4}$ to the quarter-post; found trap in place quarter of a mile ...st of the corner; after that, ground to the quarter-post low and wet; ...mlock, cedar, &c. Returned to corner $\frac{4}{3}\frac{4}{3}|\frac{3}{3}\frac{3}{4}$; went north three-quar...rs of a mile; trap continues distinctly in place half a mile; the ground ...scending from the corner to the stream a little beyond the quarter-post; ...ream; then level ground covered with hemlock and soft wood; some ...aple; returning, ground descends quite regularly all the way from ...|$\frac{33}{33}$ to $\frac{34}{0}|\frac{33}{0}$; trap in place everywhere. I place the limit of the trap on ...is line at the stream one mile and a half north of $\frac{34}{0}|\frac{33}{0}$; Dickenson ...ade the limit on the west line a little more than a mile from $\frac{34}{0}|\frac{33}{0}$; Hub...rd's map is nearly correct.

September 22, *p. m.*—Started from the northeast corner of range 41, township 39; followed the north S. line south three miles; land at first descending, then undulating; after about three-quarters of a mile beginning to ascend rapidly, and the first section corner south is *very* near the summit of a high ridge of trap; (barometer;) trap soil and fine maple timber everywhere. After passing first mile corner, first a steep descent, then several low ridges with no rock in place; then another high ridge one mile and a half south of the northeast corner; from this ridge to second section corner, or $\frac{1}{1}\frac{2}{3}$, land very uneven; ridges or knobs with no rock in place; much hemlock and soft wood; first half of third mile level, with soft wood; afterwards very uneven; poplar, birch, and cedar; camped at $\frac{1}{1}\frac{4}{4}$. I place the limit of the trap and sandstone one quarter of a mile north of $\frac{1}{1}\frac{4}{4}$, to the Minnesota Company's location, three miles; passed first a wide ridge covered with a tangled cedar thicket; second half mile more hard wood and more level; soil uniformly a red clay; next half mile country rugged and uneven; red clay soil; soft wood; same to the second section corner. After passing second corner, the ground at first, for about one-sixteenth of a mile, is rugged; then follows a level plateau, gently rising to two and a half, level of $\frac{1}{1}\frac{5}{4}$; trees hemlock, fir, spruce, and maple. After passing the quarter-post the ground rises to the third mile corner, or $\frac{1}{1}\frac{6}{4}|\frac{1}{1}\frac{6}{4}$; trap everywhere in place; maple and hemlock. I place the limit of the trap on this line about one-sixteenth of a mile west of $\frac{1}{1}\frac{6}{4}|\frac{1}{1}\frac{6}{4}$.

September 23, *p. m.*—Sent Dickenson north from the cabin of the Minnesota Company on 98, and McIntyre northwest on the road to the Ontonagon river, and took the south line myself. After leaving the high trap ridge, along the top of which runs the east and west line halving the township, the ground descends gently; a vein-like mass of epidote, containing seams of quartz or spar, with particles of metallic copper. The fragments of epidote are often covered with a thin coating of carbonate of copper, which sometimes also, with decomposed epidote and earthy matter, forms thin seams of a greenish color in the rock; these are looked upon by the miners as a very rich ore. There are several good cabins on this location, and others are being erected. Twelve miners—all, I believe, Cornish men—were at work, and all, as usual, very sanguine. The location is not well situated, the roads being, from the nature of the soil, very bad, and transportation difficult. The company proposed to erect stamping-mills at once. On the whole, appearances at this location are encouraging enough to justify the prosecution of mining, though the absence of true veins renders the ultimate success of the mine a matter of some uncertainty. In the shafts above mentioned the epidote appeared to grow richer in copper in proportion to the depth of the shaft; the "vein" at sixty feet was about eighteen inches in width.

Aspinwall's location.

About a quarter of a mile west of the cabins, on the O. T. N. Company's location, range 41, township 49, section 11. General character precisely similar to those above mentioned. The epidote is less rich in copper than on the neighboring location. Two vein-like masses of epidote, mixed with quartz and spar, meet at right-angles, north and south and east and west. Two shafts have been sunk in the course of the vein, or dipping about 48° towards the north, the first being 30, the

cond 60 feet in depth. The epidote is supposed to become richer with ıe depth of the shaft, as on the other locations; appearances are perhaps ɔt quite so favorable as on section 12. Traces of ancient mining operaons, similar to those on location 98, have been observed at several points n this range. Then comes a knob of trap called the "South Brother;" ter which, the ground is either level or very gently descending to second ile corner, or $\frac{s}{s}\frac{s}{s}|\frac{s}{s}\frac{7}{s}$. For the first half mile south of the location the mber is hemlock, gradually becoming mixed with white and yellow rch and maple as we go south. After passing the stream near the second ile corner, a thick undergrowth of cedars, &c., is met, and the general ppearance of the country indicates sandstone. I place the limit of the ap, at the stream, a little to the north of corner $\frac{s}{s}\frac{s}{s}|\frac{s}{s}\frac{7}{s}$, which must be ery near the truth; measured the high ridge south of the Ontonagon ompany's cabin, at its highest point; weather unfavorable. 24th, returned the lake; found the limit of the trap about 2½ north and one mile west the Minnesota cabins. The trail is not laid down on the map, but I lieve this is correct.

Boyd's location.

Thursday, August 10.—Left the mouth of Iron river about 8 o'clock, d reached Boyd's location at 4½ p. m. From the mouth of Iron river the second crossing of the same the rock appears nowhere in place, t everything indicates sandstone or conglomerate; trail to Boyd's locan turns off about 2½ miles from the second crossing of Iron river. ter crossing a swamp about a few hundred yards in width, a well blazed il leads to the location, a distance of about six miles. On the location a small clearing and two log huts; trap well in place everywhere. Near bed of the stream, close to the farther cabin, occurs a mass of epidote k passing into the trap, and containing specks of metallic copper. A v hundred weight of trap has been here thrown out; show of ore very or indeed. At the southeast corner of location, near the top of a trap ff 200 feet high, occurs another mass of epidote rock, which has been posed in searching for copper. The mass is about six feet in breadth 10 in length. It presents, superficially, the characters of a vein, but sses into the trap on each side and above, so as to be no longer distinishable at the distance of a few inches. A few particles of copper are nd in the epidote, but the appearance of the whole is most unpromis-. From the top of the cliff a fine view was obtained to the east and th, extending over low, well-wooded ridges to a range of hills 30 or miles distant. *Red oxide vein* about a quarter of a mile west of the ɔius, near the trail. At this place a small clearing has been made, one corner of which a few tons of trap have been thrown out in rch of ore. The trap is very hard and compact, containing epidote, d often covered with a greenish stain, $\overset{I}{Cu}\ \overset{II}{C}$. The seams are filled th thin plates of a red crumbling mineral, doubtless laumonite. The dote has, as usual, some resemblance to a vein, but there is no real n; and no specimens of copper or oxide of copper could be found. e red oxide said to have been found here was doubtless derived from all pieces of metallic copper which had gradually become oxidized. A le further on the trail another similar opening is found, but no copper.

On the whole, I see no reason to report favorably of this location. Nothing *now* to be seen would justify a continuance of mining operations at this place.

Stevens's location, range 41, *township* 49, *section* 12, *northwest corner of section.*

Ohio Trap Rock Company; general character a compact trap rock, containing much epidote, mixed with quartz and calcareous spar. The epidote generally assumes the form of veins, intersecting the trap in different directions, but perhaps chiefly east and west or north and south. In one of these "veins," running through the hill nearly east and west, dipping about 35° north, two shafts of 60 and 40 feet have been sunk, from which large quantities of epidote rock, mixed with spar, have been taken. The epidote rock is frequently very rich in copper, though as yet no large masses have been found. The copper is also disseminated, though sparingly, through the quartz, so as to present specimens resembling those from the cliff mine The epidote is often crystalline. At the bottom of the hill a drift is in progress to meet the two shafts. The hill is about 130 feet in height, and the distance to be driven 300 feet, following the apparent course of the vein. Other openings have been made on this location, and even in the same hill; but they all present the same general character.

Wednesday, September 13.—Algonquin location. Cabin, June 4, 1 p. m., barometer 730.5.

June 20, 1848.—Being detained until this time, owing to the negligence of government in providing the necessary funds, it was not till to-day that we were enabled to start for the lake. Left Boston this morning in company with the other persons attached to the survey; stopped at Northampton to procure certain things requisite for the summer campaign.

June 21.—Left Northampton and reached Albany this evening. Left Albany at 7 p. m.

June 22.—Arrived at Buffalo at 9 p. m.

June 23.—Left Buffalo this evening, and reached Detroit at 7 a. m. June 25.

June 26.—At Detroit; repaired sextant, &c.

June 27.—Left Detroit at 10 a. m., on steamer Detroit, for Sault Ste. Marie.

June 29.—Reached Sault Ste. Marie.

June 30 to *July* 6.—Remained at the Sault; took numerous observations to rate chronometers, which have changed their rates materially since leaving Boston.

July 7.—Left Sault by propeller, and arrived at Copper Harbor July 8, at 3 p. m.

July 9, *Sunday*.—Remained at Brockway's, the day being rainy.

July 10.—Removed our quarters to the fort; cloudy; no observations.

July 11 *to* 18.—Remained with Mr. Joy, at Copper Harbor, while all the other gentlemen went over to Lac la Belle, it being necessary that some one should rate the chronometers, which have materially changed their rates.

July 19.—Left for the Ontonagon region, camped near Agate Harbor, being overtaken by a violent gale of wind and rain.

July 20.—Strong head wind; got no further than Eagle river to-day.
July 21.—Heavy gale this morning; being unable to leave, we visited Cliff mine; after dinner, the wind having somewhat subsided, we rted and reached the Portage at dark, where we camped.
July 22.—Took time observations this morning, and rowed against a ag head wind to Salmon Trout river, where we camped.
July 23.—Sailed to the Ontonagon river.
July 24.—Wind blowing down the lake to-day, almost a gale, and could proceed. Took observations.
July 25.—Rowed to Iron river; wind strong down the lake; could pro- l no further. Saw Messrs. Burt's packmen, and learned that they are dividing in the region of Agogebic lake this summer. Took observa- ns.
July 26.—Cloudy, cold, and rainy. Rowed against head wind to sq'isle river.
July 27.—High wind from northwest. Remained at Presq'isle river. amined the rocks, and made sketches. Made observations.
July 28.—Rowed to Montreal river, and camped. Saw Mr. Ives, linear veyor.
July 29.—Rain all day. Remained in camp.
Sunday, July 30.—Violent rain-storm all day. Remained in camp.
July 31.—Dr. Gibbs left for falls, to make barometrical section across country. I remained with Mr. Joy, and took astronomical observa- ns.
August 1, *a. m.*—Took time and latitude observations for the determi- ion of the position of this point. P. m., measured section barometrically oss to the Upper Falls, and made drawings of the scenery; examined geological structure of the region. Measured the height of the falls ometrically.
August 2.—Returned to mouth of river, measuring section across Con- merate hill. Took observations for time and latitude. Messrs. Keller l Marcon passed this day.
August 3.—Rowed to Black river, and camped. Took time and latitude ervations.
August 4.—Northeast storm. Rowed to Carp river, and camped at rp river. P. m. cleared up, and we took time observations.
August 5.—Took time observations, and rowed to Mendenhall's ware- se. Camped, and measured barometrical section to Carp lake, and k.
Sunday, August 6.—Measured another barometrical section across the ge to Carp lake, and returned, as we wished to fix the height of the e as accurately as possible. The observations of to-day and yesterday ee to ten inches. P. m., started with Dr. Gibbs to measure the heights principal points of Porcupine mountains. Measured to Carp lake again, l thence to location of Delavan Company, where we took possession of e of the deserted houses.
August 7.—Measured barometrically a section across the ridges of Por- pine mountains, and back to shore of Lake Superior.
August 8.—Rowed to warehouse of Union River Mining Company, l camped. Dr. Gibbs proceeded on to Iron river to examine Boyd's ation. I spent the rest of the day in examining the geology of the east-

ern flank of the Porcupine mountains, laying down the details on the township plats.

August 9.—Exploring the geology of the adjacent sections; details recorded on township plats. Measured heights of principal points.

August 10.—Rain. P. m. examined the western portion of township, recording observations on township plats, and making barometrical measurements.

August 11.—Proceeded to abandoned mine of Union River Company, and thence to Carp river to determine limit of conglomerate and amygdaloidal trap, and measure heights of principal points.

August 12.—Rowed to Iron river; time and latitude observations. Dr. Gibbs returned from Boyd's location to Iron river. Rowed on towards the Ontonagon, and camped on sandy beach, about four miles east of Iron river, the wind being ahead.

August 13.—Northeast storm. Rowed about a mile, and the wind and waves being too high, we were obliged to camp again.

August 14.—Northeast gale. Could not move from this spot.

August 15.—Rowed, with great difficulty and some danger, against heavy head sea, to Ontonagon river, and immediately proceeded to location 98, distant about twelve miles.

August 16.—Examined location 98 and its neighborhood, and measured barometrically principal heights.

August 17.—Returned to mouth of Ontonagon river.

August 18.—Remained at the mouth of the river to make necessary observations for determining the position of this place. Dr. Gibbs left to examine the locations of Ohio Trap Rock and others.

August 19.—At Ontonagon; time and latitude observations and calculations. Dr. Gibbs returned to camp.

August 20.—Rain. Rowed to mouth of Fire-steel river, and camped.

August 21.—Heavy rain all day. Went to location of Algonquin Company distant two miles by river to warehouse, and thence nine miles by road. The country is gently rising, and no rocks to be seen in place until we strike the trap range, about two miles from the cabins. Location deserted.

August 22.—Examined the abandoned workings of the company, and returned to lake shore in rain storm.

August 23.—Rowed to Salmon Trout river, and camped.

August 24.—Rowed to Eagle river.

August 25.—Rowed to Copper Harbor, having been ordered by Dr. Jackson to return after having made the necessary barometrical and astronomical observations for the completion of the geological map of the district between the Ontonagon and Montreal rivers. Dr. Jackson has promised us that we shall explore a section through from L'Anse to the Menomonee, and for this purpose we have been ordered to return to Copper Harbor. On returning we found Dr. Jackson and his party here, where they have been most of the season.* Mr. Foster and Mr. Hill have nearly completed a fine map of Keweenaw point.†

August 26 *to September* 2.—Remained at Copper Harbor, awaiting Dr.

* Exploring the geology and mineralogy and mines of Keweenaw point.—C. T. J.

† Map drawn by William Schlatter, the draughtsman, and it was colored from the geological surveys of myself and party. C. T. J.

ckson's movements. Took numerous observations for determining rate chronometers; but the weather being very unfavorable, the results are ot of much value.

September 2.—Our plans having been arranged, I left this morning, in mpany with Dr. Jackson and his party, for L'Anse. The arrangements r the remaining portion of the season have been materially changed, and e parties are now to be ordered as follows: Dr. Jackson and party will ntinue upon Keweenaw point. Mr. Foster and Mr. Hill will proceed execute the laborious task of exploring a section through the iron region the Menomonee. Dr. Gibbs and Mr. Joy, with Messrs. McIntyre and ckenson, will leave Copper Harbor as soon as possible for the mouth of re-steel river, where I shall meet them in a few days. I shall proceed the Anse and there examine the remarkable deposite of limestone dis-vered by Higgins's party of linear surveyors, and cross over to the mouth Fire-steel river to meet my own party, whom I have directed to com-nce their explorations at the Algonquin Company's location as soon as ey arrive, in case I do not reach that point before they do.

Camped to day at the extremity of Keweenaw point; a sudden thunder rm coming on.

September 3.—Heavy rain. Made but very little headway. Stopped at lo-tion of Boston and Lake Superior Mining Company.

September 4.—Too much wind; could not proceed. Made sundry ex-inations in this neighborhood with Mr. Foster.

September 5.—Strong head wind; rowed, with difficulty, to point near serted fish-house of the American Fur Company; and, being too strong, e were obliged to camp here.

September 6.—Rowed, with a heavy cross sea, to point opposite Traverse and, and camped.

September 7.—Sailed, with a fine wind, to Portage lake; stopped for nner; sailed thence, with a fair wind, to Meniclier's, near L'Anse.

September 8.—Started with Mr. Barnes this morning to explore the de-site of limestone near this place. The day being disagreeable, missed e trail at crossing of Sturgeon river, and were detained, so that we did not ach the locality of limestone that evening. Camped near town line be-ween ranges 34 and 35, township 51. The whole surface of township , range 34, is utterly worthless, being low and wet. Sturgeon river ns through the centre of the township. Rock nowhere seen in place, cept once. Horizontal strata of red sandstone. The timber is mostly mlock, fir, balsam, cedar and spruce, and occasionally a large white ne.

September 9.—Left for limestone locality early this morning. It is at ¼¼, township 51, range 35. The day was rainy, and we had, un-tunately, but a small supply of provisions, so that our observations were nited to ascertaining the fact of the existence of a large deposite of lime-one, and to the fact of its containing fossils. P. m, it rained heavily.

September 10.—This morning I was anxious to remain and continue e exploration of this interesting locality, but provisions being entirely hausted, and a portion of my party having orders to join me to-day on a rtain part of the trail, and they being without a tent to shelter them, I t it to be my duty to go on to the Algonquin location, not doubting that . Jackson would be anxious personally to examine this interesting de-site, which was distant only one and a half mile from a good trail to the

Anse.* I therefore sent Mr. Barnes back to the Anse with the specimens, and continued on to the Algonquin location, a good day's work, about 16 miles through the woods. The country is rolling and cut up by ravines, but the soil is generally good and covered with a dense growth of timber. Found, on arriving at the Algonquin location, that Messrs. Gibbs and ... and party had not yet arrived.

September 11.—Remained at Algonquin Company's location, and made examinations of location and abandoned diggings; made explorations in determining limits of trap.

September 12.—Made farther explorations towards the west. Examined mine. Hill of trap mixed with epidote rock, which runs NE. and SW., elevated about 100 feet above the general level. Number of open cuts along side-hill; one is 30 feet in length, and about 10 feet in depth; the rock thrown out is mostly a mixture of epidote, with trap rock—runs N. 60° E.; richest ore is an intimate mixture of copper and epidote, and yields a very varying per centage. It is impossible to say what would be the value of this locality, though the quantity of copper found here is very considerable, and it would seem decidedly worth while to make farther explorations here.

Went to saw-mill of this company, distant about 2½ miles, over fine rolling sugar land, underlaid by trap. The mill is hardly completed, and is most miserably built; it is on a branch of Fire-steel river. The location appears now to be entirely abandoned.

September 13.—Started to explore locations of Douglass Houghton Mining Company. Examined the deserted workings of the company and their location. Returned to Algonquin Company's location, and found that Dr. Gibbs and party had arrived from the mouth of the river. Mr. McIntyre came yesterday from ————, bringing a written order to me to return to the limestone region, and make a more thorough examination of it, he himself not wishing to see it, and Mr. Barnes having refused to return to it, although it was an easy half day's walk to it from the Anse, it being about 9 miles on a good trail, and 1½ mile from the trail.

September 14.—To day it stormed violently, and we were unable to leave the location.

September 15.—Dr. Gibbs and party started west this morning to explore the trap range between this point and the Ontonagon river. I went with our two best men to the mouth of the river to procure the necessary provisions to return and examine the limestone locality; the distance being from the mouth of the river about 30 miles.

September 16.—Severe rain storm; could not leave camp.

September 17.—Heavy rain; but as we have no time to lose, we returned to location of Algonquin Company, and stopped for the night; the road was nearly impassable from the long continued rains, the mud much of the way being knee-deep.

September 18.—Still raining; went to limestone locality, about 16 miles, and camped on the hill.

September 19 *and* 20.—Explored the deposite of limestone as thoroughly as possible, and collected about twelve different species of fossils. The deposite rises to the height of about 300 feet above the general level

* Mr. Whitney, at his earnest request, was sent to examine this limestone bed, and was ordered to collect the fossils and determine the position of the limestone.

of the surrounding low and swampy country. It lies on the corner of sections 13, 14, 23, and 24, of township 51, range 35. We struck the first limestone near the quarter-post, two and a half miles south of township line. This is a low bluff, with perpendicular walls about 20 feet in height, which extends along a few rods nearly north and south, and at its northern extremity bends to the west, and may be traced as it crops out in a small ravine till it finally disappears. Passing further to the south, we next came upon the limestone to the west of the line which gradually rises, and the section-corner three miles south of the township line is directly upon the summit of the hill, which appears to be made up of limestone. On exploring in each direction we found that the west line from this corner led us to a precipitous bluff at least 50 feet in perpendicular height and about 150 feet above the valley below. The limestone is indistinctly stratified, and dips from 0° to 30° at various points as measured by me. It is a light buff color, so quartzose in some places as to strike fire. It contains numerous fossils at certain points, but the greater part of the rock seems to be entirely destitute of them. We obtained stems of encrinites in great abundance, othocenatites, and numerous other fossils, quite difficult to name from their imperfect condition and from the fact of their being only casts. The country around is low and swampy, and is only at rare intervals that rock can be found in place; still the indications around are nothing but sandstone, and horizontally stratified. Now the limestone is apparently inclined at an angle of 30°; and if this be the case, it seems evident that the limestone is the oldest rock; though, again, it cannot be denied that the stratification of the limestone is very obscure, and in some places it appears to lie nearly horizontally. If no other data can be collected than those which I have already, I should hardly feel willing to pronounce which is the oldest formation. Perhaps the explorations of another season will enable us to decide with certainty. The weather was rainy during the whole of the three days which I spent here; and it was impossible to remain longer, on account of the lateness of the season and the necessity of attending to the party exploring between Fire-steel river and the Ontonagon.

September 21.—Returned to the Algonquin Company's location.

September 22.—Returned to the mouth of the river, and there camped, waiting for Dr. Gibbs and party to come down from the Ontonagon and join us, to return to Copper Harbor—this being the time when we were directed to return to headquarters.

September 23.—Remained in camp, waiting for the arrival of the other party.

Sunday, September 24.—Dr. Gibbs and party came in to-day.

September 25.—Gale of wind: could not leave.

September 26.—Left at 2 a. m., and, being favored by the wind, reached Eagle river at 5 p. m.

September 27.—Walked to Copper Harbor; which place we left on the 30th for Sault Ste. Marie; which place we reached on the 3d of October.

Remained at the Sault till the 6th, but were unable to take any astronomical observations, as the weather was cloudy, and has been ever since we arrived at Copper Harbor.

We separated at Mackinaw; and I reached Boston on the 19th of October.

B.

Copy of instructions to Mr. J. D. Whitney, jr., assistant geolo

SIR: In virtue of authority vested in me by instructions receiv the Secretary of the Treasury, I hereby appoint you to be a *first a geologist* on the geological survey of the mineral lands of the States in Michigan.

Your services will commence on this first day of June, 1847, a pay will be, according to instructions given me by the Secretar Treasury, five dollars per day—you paying your proportion of penses of travel, and for supplies of provisions, tents, boats, &c. vided in my instructions; your travelling expenses from your h Lake Superior and back again to your home being allowed you government.

It is my wish that you should take charge of the western par mineral-land district, beginning at the Montreal river, on the bou Wisconsin, and examining the country eastward—keeping, as far ticable, in company with the corps of linear surveyors now at v that district. The linear surveyors will be instructed by the s general to give you all the assistance in their power; and you will less encamp with them, and pay your proportion of expenses of li advised probably by the surveyor general, according to my instr received from the Secretary of the Treasury.

In your survey, you will please make careful search for ores and and examine the different rocks and minerals, obtaining two speci each rock, mineral ore, metal, or fossil—one specimen of each of should be a fair-sized cabinet specimen, for the use of the gove while the other should be of sufficient size for accurate descri analysis.

You will be expected to make very exact observations on any bed of metalliferous ore or metal you may discover, and to give details required for the determination of the economical value of calities for mining purposes. The courses, dip, and width of vei their extent, so far as they can be discovered, should be ascertain noted on the spot; and fair average samples of the ore should b for chemical analysis and assay.

You will also please to notice the character of the soil, and the of the forest trees; and where you deem the land to be of agri value, you will collect samples of the soil for analysis. In addi the usual duties of a geological explorer, you will also keep an a account of the topographical features of your district, and make s of remarkable or interesting scenery. Barometrical observations wi quired at 2 p. m., mean time; and also on all the hills you may ascer time of observation being noted. Observations of the temperature o and of the dew-point are also required, when practicable to make periments. Observations for latitude will also prove useful, and v to our geographical information, and prepare the way for a series minute observations of latitude and longitude, which we hope t when furnished with good chronometers.

In describing the country, please notice the width and general

the rivers, the capacity and goodness of harbors for boats and ves-
and give as complete an account of your observations as possible.
ıave called your attention to a few points, some of which must be
)usly requisite, in giving an account of the country you are called to
ıine; but I wish you also to use your own judgment in recording any
observations that may be regarded as useful to the public or interest-
o men of science.

Respectfully, your obedient servant,

CHARLES T. JACKSON,

Geological Surveyor of U. S. mineral lands of Michigan.

r. JOSIAH D. WHITNEY, jr.

Field-notes for 1847.

hursday, June 3, 1847.—Left Boston at 8 a. m. in company with
srs. Barnes (who acts as sub-agent on the survey) and McIntyre and
:enson who are employed as packmen. We reached Albany at 6½ p.
where we remained till the next morning. Called at the State geo-
:al rooms and examined the collections of the State survey.

ne 4.—By railroad to Syracuse, where we remained over night.

ne 5.—To Buffalo.

unday, June 6.—We remained at Buffalo.

ne 7.—Left Buffalo by steamboat.

ne 8.—Reached Cleveland at 11 a. m., and Detroit at 11 p. m.

ne 9.—Purchased provisions and supplies for the use of the survey.

ne 10.—Finished purchases; adjusted sextant. Saw Bela Hub-
, esq., and Hon. Lycius Lyon.

ne 11.—Waiting for the arrival of Dr. Jackson and party, who came
½ p. m., accompanied by Messrs. Peabody, Dunlap, Channing, and
r gentlemen attached to the survey.

ne 12.—Spent the forenoon in Mr. Lyon's office looking over maps
plans and conversing about the survey. In the afternoon I arranged
distributed the township plats, and prepared other things for the survey.

unday, June 13.—Left Detroit at 11 a. m. in company with Messrs.
nes, Dickenson, Dunlap, and McIntyre, for Sault Ste. Marie, by
mer Champion. Weather clear and fine. Soon after leaving the
ıth of the river the weather became threatening.

ne 14.—On getting up in the morning we found that we had made
little headway, and we were soon obliged, by the increasing gale, to
back and return to shelter near Whiterock, where we remained till 5
ı., when, the wind having moderated, we started again, and ran on
nst a heavy head wind, making but little headway against it.

ne 15.—This morning a strong head wind, and we make but slow
ress. At 11 a. m. passed Thunder Bay Island lighthouse; made
e Presq'isle at 2 p. m. Wooded at Presq'isle at 4 p. m. Arrived
Mackinaw at 12, midnight.

ne 16.—Left Mackinaw at 1 a m. and sailed up the river with a
t head wind to the Sault, where we arrived at 2½ p. m. Stopped at
Ste. Marie House. Saw Messrs. Livingston, Gratiot, Libby, Bar-
, Hempstead, &c., &c.

w specimens of copper pyrites, in quartz, from Drummond's island;

Engaged voyageurs for the summer, and made purchases of su articles which we had omitted at Detroit.

The Julia Palmer arrived to-day; we shall probably leave on soon as the next boat arrives from below.

June 18, 19, 20, 21, 22.—Remained at the Sault waiting for the of a boat from below; made astronomical observations for latitude.

June 23.—The steamboat Ward arrived at 8½ p. m., bringing Dr son and his suite.

June 24.—Left Sault Ste. Marie by the steamer Julia Palmer at with our whole party on board.

June 25.—Passed the Pictured rocks at 10–11 a. m.; landed at island; took latitude observations.

June 26.—Arrived at Copper Harbor at 12½ a. m.

Sunday, June 27.—Moved to Fort Wilkins this day, and took sion; arranged instruments and stores.

June 28.—Took time and latitude observations.

June 29.—Left Copper Harbor with all our party, to visit the p mines.

June 30.—Visited the abandoned mines of the Lake Superio pany; examined the heaps of rubbish lying at the surface. Dr. J and others descended into the mine. I remained above and to and latitude observations.

July 1.—Took time observations, and then with the whole party the Cliff mine. Measured the height of the cliff barometrically vations given to Dr. Jackson at the time. Examined the mine pany with Dr. Jackson, by whom the observations were recorded.

July 2.—Returned to Sand bay, and thence to the location of t per Falls Company; returning to Eagle Harbor at 6 p. m. De into the mine with all the party. Observations recorded by Dr. J Saw at the house large and fine crystals of analcime; also red ar or sarcolite, in beautiful groups and geodes in vesicular trap; carb

nes not being in my district, and I not being expected to re-
n, I did not record my observations, but handed them to Dr.
the spot.*
Returned to Copper Harbor.
Took latitude and time observations.
Latitude and time observations. Calculated observations, and
ations to leave for the Ontonagon.
At 4 p. m. left Copper Harbor in company with Messrs. Ber-
arnes, assistant sub-agents, and Mr. G. E. Smith, instru-
man, with two excellent Indian voyageurs, Macadebines and
Went as far as Eagle Harbor that night.
At 6 a. m., weather suffocatingly hot, rowed to Eagle river;
make a few purchases; left again; noticed almost every con-
iety of boulders and pebbles on the beach; flint, agate, sand-
lomerate, trap, porphyry, (red base, with green crystals of
estone full of fossils, corals, cyathophylla, masses of favorite
, generally small and much worn. Query: What is the
ese loose masses of limestone? The rocks exposed along the
nd Eagle river, are sandstone, fine grained, red and gray, in
nds from a few inches to a foot in thickness, or else the gray
ich seem to be more argillaceous than the red, and to contain
of iron, lie in patches in the red variety. The strata dip to-
ke at an angle of from 2° to 5°. In general the strata become
horizontal as we approch the Ontonagon. Beyond the Port-
stone rocks are from 30 to 60 feet in height, perpendicular, and
umerous caves and arches at their base. The rock shows no
action of water above 10 to 15 feet, and there is no reason to
ie appearance of the cliffs at this point that the lake ever stood
level than at present, since all the arches might evidently have
l by the action of the water, at its present height, during
s of wind. The rock is very friable, and breaks into an in-
er of small fragments when struck with the hammer; no
anic life in any of the specimens which we examined, although
ed numerous impressions and marks which might readily be
r the traces of organic remains. Beyond Eagle river the
y rise above the level of the lake, and are covered by sand.
ince of the country inland is flat and scrubby.
Left our camping ground at 6 a. m.; arrived at Elm river to
w Mr. Higgins, the younger, who informed me that his father
ding on and near the fifth correction line, and that we should
et him at the mouth of the Ontonagon river. Sailed from Elm
find wind, and camped at dusk on the sand about four miles
gon. Rocks brownish-red sandstone, perfectly flat, and break-
e and perfect rhombohedra.
Reached the mouth of the Ontonagon at 8½ a. m., weather
hot, and mosquitos very annoying. Wrote to Dr. Jackson
im of our arrival. Judge Burt had not yet been at the mouth
Mr. Higgins had left the day before, taking all his provisions

; true; Mr. Whitney never handed me any of his observations concerning any
l on Keweenaw point. I took him with me to show him the mines, so as to pre-
servations elsewhere.

C. T. J.

east of the place where the fifth correction line crosses the river
Higgins advised us to wait here till Judge Burt arrives, and leave
for him at the post nearest to the point on the correction line to wh
is expected to close up. He describes the country between the F
and this point as very uninteresting. The trap range does not app
the surface except in a very few places; only a few indications of
He also informs me that no limestone occurred in place north of Lac
desert. The country up the Ontonagon, from its mouth, is the
I have seen in this region. No rocks are seen in place; the ban
from seven to ten feet above the river, and covered with a fine gro
elm, lynn, sugar maple, black and white birch, spruce, white pin
sam fir, cedar, hornbeam; also an abundance of wild roses, gooseb
raspberries. Several persons have made clearings on the river bank
built small shanties, nearly all of which were deserted at the tir
passed. Potatoes were thriving. Saw at the mouth of the river ma
native copper, with red oxide, from Boyd's location.

July 10.—This morning started with Mr. Higgins, and went two
east on the fifth correction line, leaving three letters for Judge Burt
many quarter posts. No rocks seen in place anywhere on the line.
whole country is broken by frequent ravines, or hog-backs, as th
called, caused by the action of currents of water on the clay which
the rocks to a great depth. The timber is most hemlock and sugar

July 11.—Left this morning for the location of the Ontonagon
Company. Vein, or vein-like mass, of epidote; runs in drift nor
east, south 80° west; on top of hill bears south 9° east. Extremity
bluff seen from hill; bears north 25° west; width uncertain. Massi
dote with quartz, calc spar, chlorite, epidote rock, amygdaloidal
filled with calc spar. A drift is run in 30 feet, with a side cut to m
vein. Epidote irregularly distributed through the rock; no signs of
lar wall rock remarked. Epidote crystalline, and slightly decom
Copper scattered through very much as in Isle Royale specimens

, too, at some distance from the main body of the epidote, large hes of trap apparently gradually passing into epidote rock, without marked line of junction being seen.

1 the drift nearest to the top of the hill, which is driven only a few feet, rock becomes entirely decomposed after a short exposure to the air; little or no copper is seen. In digging for the wheel-pit, at the bot- of the ravine, a mass of pure copper, weighing 50 pounds, was thrown . Opposite, a few feet higher up, the epidote is seen again, but no per; but quartz, which contains a few specks of native copper. In er to test the value of the deposite, Mr. Cushman must sink upon it at lowest drift, and see whether the quantity of copper increases. Un- s the quantity of copper increases, the mine must be abandoned.

The rocks on the road from our camp to Cushman's are conglomerate side hill 2½ miles from the river, and there trap. The timber is mostly ple. A few black oaks are seen upon the hills near Cushman's.

July 12.—To-day started for Cushman's, intending to make an exam- tion of the trap range on and near the west branch of the Ontonagon, luding Mendenhall's location, the United States Mining Company's, ., &c., to endeavor to trace the origin of the famous copper rock. out a quarter of a mile from our camp met two of Burt's packers, who e in search of provisions for the two parties of John and Austin Burt. ge Burt himself is on the boundary line between Wisconsin and higan. He will, however, soon be here, as he has no provisions left. nt our men and boat to the mouth of the river to transport provisions Messrs. Burt, inasmuch as I expected to be attached to their party, considered it my duty to further their interests as far as possible. Mr. nard left with one of the packers to find one of the Messrs. Burt, and rm him of our arrival. I remained in camp, copying a map of this ion for our use. Our boat returned in the evening with provisions for ge Burt.

July 13.—Our boat and men started up the river with provisions for ge Burt. I remained in camp waiting for the arrival of some of the ties. Examined the clay hills in the vicinity of the Ontonagon, and asured their height. Our boat returned this evening, having with iculty ascended as far as Baltimore creek, with 1½ barrel of flour and f a barrel of pork.

July 14.—To-day Mr. Bernard returned, having seen Mr. Austin Burt, examined the diggings of the Vulcan Company. They are mining he clay for trap rock, without aim or object. The Messrs. Burt will at the correction line on Saturday.

July 15.—Left camp this morning to explore in the neighborhood of shman's. A blast put in this morning brought out a few pieces of de- posed epidote, containing a little native copper, and surrounded by oxide and green carbonate of copper. Width of rock filled with dote, calc spar, and quartz, about 16 feet at surface of cliff. In sting for the wheel-pit they have taken out some native copper from compact trap, where it occurs in small quarter to half-inch veins of monite and quartz, on the banks of the stream. Determined the rse of the vein-like mass at Cushman's to be north 76° east, south west; measured barometrically the cliff in which the mine is situated. er dinner we started for the copper-rock road, but a tremendous thun- shower burst over our heads, and we were soon drenched and bemired.

eral others adjoining. Diggings near the house examined; a mass o
bish has been thrown out, mostly trap, with epidote intermixed,
very little copper. The excavation is at the base of a trap cliff abou
feet in height. No regular vein could be perceived. Excavation fill
with water. The company have explored several epidote masse
have met with but little success. Remained here during the rest o
afternoon during a tremendous thunder storm, which effectually
vented further exploration.

July 17.—Left the United States location early in the morning
proceeded nearly west to No. 295, where the Ohio Trap Rock Com
has a cabin, and has been exploring. There are three men now o
location. Here, as well as at the United States location, they h
clearing planted with potatoes. Peas were nearly fit to eat, and
carrots, and lettuce were looking up. From the cabin we went
two miles south to the cabin occupied by the American Exploring
pany. This company has no permit or lease. The house is
high trap cliff, which rises at an angle of 46° to the height of 30
above the cabin, or 400 feet above the river at its base. We climb
the face of the cliff over angular fragments of trap rock of all form
soon reached the summit, where they have opened a vein of quar
epidote containing native copper. The bluff here runs nearly nort
south, and the course of the vein is also nearly east and west. It dip
47° to 49° to the north. The vein has been traced for a consid
distance along the brow of the cliff. It varies much in width and
acter. In one place it measured 12 inches in width, and consist
partially decomposed epidote and chlorite; wall-rock well defined
erally separated by selvages of chlorite or argillaceous slaty subs
In a few feet distance the vein narrows to three inches, and cons
quartz, with radiated epidote and native copper, and red oxide,
curious vermillion hue, and much stained with carbonate of c
Further on the vein is almost entirely quartz. Here there have

in the same cliff, where the Ohio Trap Rock Company has made ght explorations. Vein epidote and quartz in trap, runs nearly east l west; dips to north 45°. This is more properly a vein-like mass n a vein, and its true nature and value cannot be determined without ther explorations. The epidote has thin films of copper between the ural joints, and contains this metal disseminated through it in fine ticles, like specimens from Isle Royale.

The company has done no regular mining as yet, but expect to comnce soon with a gang of miners. After examining another cut which y had made in another vein-like mass, similar in character to the ers we had seen, we returned to the cabins, where, in the absence of proprietors, we ate up everything that we could lay hands on. Mr. aig, the agent, said that they had wasted much money on the exration of their location, in order to discover the real nature of the ins. He says—what we ourselves have also discovered—that on the s of the cliffs or ridges epidote is everywhere found, without being regular or workable veins; also that there are many north and south ts or depressions, in which loose masses of epidote have been found ntaining copper. These have been frequently mistaken for veins, and ve been reported as such. After dinner we returned to the United ates location, and from thence home to our camp at Cashman's warehouse.

Sunday, July 18.—Remained in camp.

July 19.—Remained in camp waiting for Judge Burt, whom we expect ery moment. Copied map of district between Montreal and Ontonagon. ssrs. Randolph and other gentlemen passed up the river. In the evening our boat returned from the mouth of the river, bringing a letter from . Jackson, who is making a picturesque tour round the lake on board e Julia Palmer.*

July 20.—Crossed river and measured the plastic clay bluffs rising from e edge of the river the other side of the Grand rapids. Found in the y pebbles of all sorts—among others limestone and corals; clay, dark l, tough; and good growth of timber, mostly hemlock.

Two of Burt's packmen came in and gave us the welcome intelligence at their parties would meet here to-day or to-morrow. Weather rainy d suffocatingly hot.

July 21.—Judge Burt came in this morning, and taking our boat and en, and accompanied by Mr. Bernard, descended the river for provisions; returned the same evening.

July 22.—Austin Burt came in this morning, and John Burt, with their rties, in the afternoon; so that we were in the midst of a pretty large semblage, including some of Mr. Higgins's packmen. Judge Burt ve us much information with regard to the country he had traversed is season and the last. Below the trap range, which extends along rth of the Ontonagon, the rocks are rarely to be seen cropping out. All the rties described the features of their last lines as the same, namely: low p knobs rising at considerable distances from each other, and destitute mineral contents. On the boundary line between the forks of the

* This is a gross misrepresentation. I was on my voyage to Isle Royale, and in this trip to Pointe and Isle Royale was constantly occupied with geological and astronomical observations.

C. T. J.

Montreal and Lac Vieux desert, Judge Burt found the rock in pla
twice; it was sienite. The Judge found the most interesting coun
year, marked on the map as trap and hornblende slates. He descri
iron region as one of great interest. It would be impossible to do ar
in this part of the country without a solar compass, as the needl
quently reversed. Judge Burt is making a geological survey, in c
ion with his linear work, as was done last year, as his contrac
same as then; and, moreover, he has received no instructions to
us into his parties,* or notification of our being in this part of the co
He was, however, willing to do all that he could for us; but as I
not calculated on any addition to his party, he concluded that he
only receive one of our party, with one packman to aid him; he
short of men, I despached Mr. Barnes, with Macadebines, to acco
him. They are to go in on Judge Burt's line, and return on the
line of the three; and by going out on the E. and W. lines, he w
quire a knowledge of a strip of country 18 miles wide, especially as
Burt is willing to collect specimens from the other lines and bring th
I intend in the mean time, with Mr. Bernard, to visit the trap range
the west branch of the Ontonagon, as far as Agogebic lake; and wh
examination is completed, we shall return to the Grand rapids a
move our boat and provisions to Iron river, and from that poi
plore the Porcupine mountains, going out on the fifth correction lin
exploring on each side. I shall return to Iron river to meet Judge
party in about 22 days.

July 23.—This morning early, Barnes left with Macadebines to a
pany Judge Burt upon his lines. We struck our tent, and packed
sions for several days, and the necessary instruments, and procee
Cushman's, where we found all Burt's parties united. Here we g
ner, and proceeded on to the location of the United States Com
examined several openings in the trap bluff, which runs near the
there are no regular veins, but patches of epidote, with spar and
mixed together, which may be found at almost any point, especia
the summit of the bluffs. The bluff, here, has a course nearly N.
and S. 70° W. The epidote here contains but little copper. Fr
bluff, looking south, we saw a country little broken by any ric
elevations; in the distance, say 15 or 20 miles south, several low l
Bearing of southernmost knob S. 46° E. The bluff descends qui
cipitously on the south side, say 200 feet, to the Ontonagon river,
a mile distant. Our course to location 295 lay along the edge
trap bluffs for a couple of miles; thence we diverge a little to the
and leave the edge of the ridges. Distance to Ohio Trap Rock Com
location 4½ miles from United States location; camped here.

July 24.—Started at 8 a. m. for the location which was worked
Mendenhall, and purchased of him by the Isle Royale Compan
since called the Mendenhall Company. Leaving the camp, we asc
the steep bluff, holding nearly a northerly course towards Menden
Ascended 100 to 150 feet, and then gradually descended, passing ov
ridges all the way to Mineral creek, which we followed down
mile. On our way noticed many boulders of granite and one o

* Mr. Whitney had a letter from me to Judge Burt, containing the orders of the Sec
the Treasury.

C.

ate, but no rock in place till about one mile north of the township line, n a hill descending from the eastward; on one side of which the rock as uncovered to a considerable extent—a sort of porphyry; base, reddish iartzose; substance, fine, compact, with crystals of flesh-colored and assy felspar. On weathered surfaces, the crystals of felspar are white, ing partially decomposed. Proceeded on to Mendenhall's, on Mineral eek; about one-half mile from houses, found two men at work in a le cut into hill from stream, in gravel, trying to trace the vein into the p. The gravel was made up of huge boulders of every variety of prim- e rock. There are now only two men employed on the location. A ge number of miners were employed for a year, and several shafts nk. The deepest shaft is about one hundred feet; but as it was nearly ll of water, we concluded not to go down it. About $10,000 have en expended here in mining, clearing and making roads. The soil is cellent. Potatoes grow admirably, and every variety of kitchen-garden uff is in a thriving condition. The direction of the vein, according to r. Mendenhall's measurements, is N. 17° W., S. 17° E. The vein is the conglomerate and sandstone, and consists mostly of spar, (carbon- e of lime, which occurs here in fine crystals, six-sided prisms, dog- oth variety, and some rare hemihedral forms,) together with heavy ar, (which is also handsomely crystallized, and in crystalline masses of e cock's-comb variety.) The ore is the gray sulphuret of copper. Vein ries in width exceedingly—sometimes split up into fine threads, and tirely disappearing for a considerable distance, the veinstone seeming form a cement between the pebbles of the conglomerate. The richest ces which had been taken out lay in the office; width of solid ore, m four to five inches. Only a few barrels of rich ore had been ob- ined. Mostly a poor ore, consisting of spar mixed with the conglomerate, d some sulphuret of copper, yield say one to five per cent. The ain shaft was carried down to a considerable distance below where ore as found, till the sandstone was struck, or till they had sandstone der the vein, the vein pitching to the west at a gradually increasing gle. Proceeding to the south, the vein evidently became poorer; and hen they had sunk on the vein a few rods south of the main shaft, and few feet in the rock, there was no copper, but a curious mass of veins agate, with calc spar, in a kind of altered sandstone. The vein is here idently near the junction of the conglomerate and the trap; and the ck offers every variety of form, resulting from the proximity of the latter ck. In the bed of the stream we saw the conglomerate, and traced e vein along into an altered sandstone, resembling trap, for some dis- nce. Below, on the banks of the stream, a few rods distant, we found highly argillaceous, slaty sandstone, dark-colored, splitting with the eatest facility into rhombohedral fragments—dipping 20° to NE. The il here is excellent. In sinking their shaft, they had to cut through early thirty feet of clay. They are trying now to trace the vein in the p, and are near a very hard metamorphic sandstone, evidently in the oximity of the trap. It is not at all probable that they will find any e if they ever succeed in tracing the vein into the trap. Heavy rain all e afternoon, and clouds of mosquitoes drove us away as soon as we uld manage to leave.

July 25, Sunday.—Rain all day. The thermometer at 4 p. m. 46°. mained in camp.

July 26.—This morning sent Mr. Smith and Kebikijiko back to the Grand Rapids for a further supply of provisions, and started with Mr. Bernard on the trail leading to the vein on the bluff where the Ohio Trap Rock Company is about to commence working a vein of epidote and quartz. Our course was nearly SW.; distance to bluff, two miles. Crossed one ridge, and down again over small stream running into the west branch of the Ontonagon, and ascending and descending till we reached the bluff at the mine, which is one of the highest points of the range. (Barometer.) Proceeded along the edge of the bluff where the vein has been traced for some distance; carrying, however, but little copper on the average, although some spots furnish quite handsome specimens. Mr. Craig has found both gray and yellow sulphuret of copper in small quantities in the vein. The company are now making preparations to work it; but it seems hardly probable that the operation should prove successful, unless further discoveries should be made. After following on the vein, we proceeded along the edge of the bluffs westerly to the termination of the same, and climbed several high trees, to describe the situation of the country. We could see from Lake Superior all around the whole circle to the point where the view was intercepted by the range of the bluffs. Rock compact trap, wherever seen in place. Descended the bluff to cabins of American Exploring Company; then decended to river and took barometrical observations. Ascended over huge angular fragments of trap, and repeated barometrical observations. Returned to camp. Kebikijiko returned from the Grand Rapids with provisions. Messrs. Aspinwall and Cleemes passed our camp to-day.

July 27.—This morning, in company with Mr. Bernard, ascended the hill north of our camp; passed, on the edge of the same, an opening in the rock, where a curious epidote and trap breccia runs irregularly through the hill, with minute specks of copper; passed town line and went on about one mile to where the reddish porphyritic trap is seen; ascended the hill, which we found composed of the same rock, and that it was an isolated hill, one of the highest points—if not the very highest—which we had been on, on this range. We named it Porphyry hill. It is covered with sugar-maple and hemlock. Took barometrical observations, and climbed a tall hemlock, from which we had an extensive view of the whole country lying to the NW., and round to the SE. To NW. Lake Superior and the valley of Iron river, a country gradually descending from the trap range without break or variety of surface; the Porcupine mountains in the distance, to the N. of W., rising without any high land between us and them, till we came to the high bluff and ranges of the Ontonagon trap range. To the S. of W., distant 6 or 8 miles, a number of precipitous bluffs are seen, near which is Agogebic lake. Beyond, and to the south of the trap range, there seems to be a continuation of the Porcupine mountain range, and a chain of elevated land, with broken and trap-like aspect, is seen to extend apparently in the same direction as the ranges of the Porcupine mountains, till it breaks off suddenly at a point S. 22° W., as seen from the bluffs of the American Exploring Company. Beyond this abrupt termination there is a flat and perfectly monotonous country to the south, with a horizon scarcely broken by any elevation, however trifling. The several heights and ranges of hills which constitute what is usually called the "trap range" are seen to great advantage from this spot. They seem to run nearly at right-angles with the general course

he range. Along the whole course of the range there seems to be a de-
ssion in the centre, both ends of any separate line of hills being higher
n the centre. Aloug the range, looking westwardly from this point,
see bold and precipitous bluffs rising on the southern edge; in the centre
vampy hollow with comparatively low undulations; then rising again
the northern edge, though not as abruptly as to the south. Barometri-
observations. After taking barometrical observations, descended in
direction into a swamp; ascended the range of hills, just under the
w of which we were encamped, and, after going about two miles,
ck the broad trail from U. S. location to Ohio Trap Rock Company's
ıtion. P. m, descended to the river; took barometrical observations.
e river is here about fifty feet in width, and from one to three feet in
ıth. Returned in bed of Cascade river; no rock in place; boulders
ıandstone, hornblende rock, and porphyry; junction of trap and sand-
ne at or near river, but concealed by overlaying soil and detritus.
Heavy rain this afternoon and night, and cold chilly weather. Ther-
meter sank 40° yesterday.

July 28.—As the rain still continued, we remained in camp this morn-
. About noon struck tent, and commenced our westward march;
ted at American Exploring Company's, and then proceeded on about
r miles in a WSW. direction through a level country, abounding in
: maple and hemlock, with a few noble white pines, to the western lo-
ion of the same company. Here are two small cabins on two locations,
no one residing here, no mining operations going on. During the
ht, heavy thunder showers and clouds of mosquitoes made our habita-
ı, leaky as it was, far from comfortable.

July 29.—This morning heavy showers of rain admonished us of the
:leness of the weather, but we nevertheless proceeded to make exami-
ions around the location. To the SW. of the cabins ascended a high
ff, looking W., from which we had a good view of the bare, precipitous
ff, bearing W. 2½° N. and W. 5° S., at the foot of which, we were
l, lay Agogebic lake; between us and the bluffs lay a swampy hollow;
tance to highest bluff estimated at four miles; descended bed of small
ırse nearly NE.; going about a quarter of a mile, found a vein-like mass
:pidote in bed of the brook, with quartz, copper-stained spar, and preh-
e, with native copper interspersed in small quantity through the mass;
dote in the centre, but no copper with the epidote. On one side amyg-
oidal trap, with prehnite and quartz exactly resembling in appearance
cimens found on the Little Montreal river; then again the same appear-
:e on the other side of the vein-like mass of epidote. No appearance
ı regular vein—could only be traced a short distance; when leaving the
ok it disappeared under the soil. Great numbers of pieces of black argil-
eous sandstone were seen in the bed of this brook, but not found in place.
: followed the stream one or two miles, till it lost itself in swampy
und. Returned to houses and started west for Agogebic lake. We
re not able to obtain any definite information with regard to the country
ond this point, and we moved on, trusting to compass, and endeavor-
to follow the principal range of trappean rocks, in order to explore its
tents. We had heard the distance of Agogebic lake from these cabins
iously estimated at from four to twelve miles. There is a trail from
: lake to the mouth of Iron river, but none in this direction, as far as
could judge. After starting, we were soon entangled in a thick cedar

swamp, in which we continued for about one mile and a half; we then began to rise gradually into a fine maple country, and, at a distance of about three miles and a half, we came to the first bluffs; we then continued along the sides of the talus till we passed the mural face of the bluff; we then ascended the side of the cliffs, but could not ascertain the position of the lake. We therefore followed along the trail made by Judge Burt's horses, bearing about SW. The rocks are a compact porphyritic trap, rising in precipitous bluffs from 300 to 400 feet. Barometrical observations were taken at the most important points. The rock is entirely destitute of mineral contents. After proceeding in a westerly direction until dark without reaching the lake, we camped on the summit of a high hill of red quartzose and porphyritic trap—wet through and worn out by the pelting of a driving rain storm.

July 30.—Pouring rain all day; remained in camp and made ourselves comfortable.

July 31.—Rain pouring all day. Mr. Bernard went westwardly, exploring the nature of the country, while I examined to the north. Found the country destitute of interest in view of mineral wealth, all the rock in this neighborhood being a hard quartzose trap, porphyritic. The base is a reddish compact quartzose material, with crystals of felspar sparingly distributed through it. Ascended high hill to SW., evidently one of the highest points of the trap range; had a fine view of the surrounding country. Mr. Bernard returned this evening, having been west to the Iron river trail to Agogebic lake, and two miles beyond. The country is both rocky and swampy, and difficult to traverse. The quartzose rocks seem entirely destitute of mineral contents. We are now encamped near Boyd's location, but not knowing its situation we are unable to find it.

August 1.—This morning, the weather being propitious, we struck our tent early in the morning, and moved westward to the Iron river trail to Agogebic lake. Our course, nearly W., took us over a very high portion of ground, probably the highest portion of the trap range west of the Ontonagon. From the summit of a high hill we saw portions of the surrounding country, but could not find a point from which a good look-out could be obtained. Barometrical observations. Rock porphyry, similar to that seen on Porphyry hill, near location of Mendenhall Company. On descending the hill we encountered the worst swamp which it was ever my fortune to be entangled in. Rocks, roots, snags, and water seemed combined together to form an almost impassable barricade. Forcing our way through with the greatest difficulty by passing the instruments from hand to hand, we struck a rocky tongue of land, and passing over about three miles of good maple land, we struck the Iron river trail, which we followed to the lake, distant from the point where we struck the trail to the lake four miles. Soon after striking the trail we left the red quartzose trap, and came upon the dark compact variety of greenstone trap. Near the lake, taking a trail to the right, we rose abruptly on to a high bluff which faces the lake, and discovered a small kennel-like habitation, but unoccupied. This is the location of the "Charter Oak Company." There is also another house near, and preparations had been commenced to erect more substantial buildings, and a large clearing had been made and planted with potatoes. Climbing the high bluffs near the house and up a tall hemlock, we had an uninterrupted view of the country for many miles in every direction.

he southeastern side of the lake the country is flat and swampy; on western side a range of trap hills comes down in a NW. and SE. dion apparently, and seems to terminate abruptly. Examined the bluffs nd the cabins, where explorations have been made; saw large quantiof massive epidote rock mixed in with the trap, and passing gradually it. No regular veins or appearance of veins could be detected. No er beyond mere specks and minute traces could be found in the heaps ock thrown out, and there is evidently no prospect of profitable min-

After examining around the cabins, we returned on the trail to a it where a blazed tree seemed to indicate a trail to Boyd's location, it being late, and our provisions being nearly exhausted, we were ged to leave it unvisited for the present. We camped at a point on trail about three miles north of Agogebic lake.

August 2.—This morning, the weather continuing fine, returned along trap range, examining the rocks. Camped at the base of a high preitous bluff, which we named Red cliff. Took barometrical observans, and ascended to the edge of the cliff. The hill is about 400 feet ve its base, and rises almost perpendicularly. The rock is a reddish artzose material, porphyritic, with small and sparse crystals of felspar ttered through it. From the summit of this hill we had the most exsive view of the whole region which we had traversed. In front, king south, we saw a swampy valley, through which runs the outlet of ogebic lake. Another range of bluffs rises beyond the low valley, the rthern range being the red porphyritic trap, the southern of the comt greenstone trap, both apparently quite destitute of mineral contents. e soil is excellent when not swampy, and covered with a dense growth hemlock, birch, lynn, and sugar maple. The porphyritic trap has a more less distinct prismatic cleavage. The rock is full of fractures, and imnse masses are constantly being thrown off from the face of the cliff the action of frost and other atmospheric agencies. Camped at the e of this cliff.

August 3.—Heavy rain; waded through swamps, and returned along trap range to the location of the United States Company, where, the ather being very rainy, we stopped for the night.

August 4.—Weather still rainy and disagreeable. Started for Randlph's location, passing Cushman's. Passed over the copper-rock road, which the famous mass of native copper found in the bed of the Onagon was transported to the main branch of this river. Banks of the er bordered with high clay hills, which are worn by the action of water o innumerable ravines with sharp crests, which are exceedingly faing to travel over. Reached Mr. Randolph's almost exhausted from and fatigue, the weather for several days past having been very wet. v fine masses of coralline limestone picked up in the bed of the river r here. Opposite, on the other bank of the river, rise several knobs trap, known as the Middle and South Brother.

August 5.—This morning rain still continued. Started early and exned the diggings in the bed of the small stream near the house. It most curious intermixture of epidote and calcareous spar in amygdaal trap. The workmen say that they have discovered a wall-rock on side, and that the width of the vein is more than eight feet. The rse is NE. and SW. There is evidently no vein, but simply a change he nature of the rock on one side of a divisional plane in the trap.

The quantity of copper is small, although some specimens have been obtained containing, perhaps, 20 per cent. of copper. They had run in a drift about 30 feet, when they found the nature of the rock entirely changed, or, as they expressed it, the vein cut off entirely by another division plane in the trap. They had tried to find a continuation of the same mixture of epidote and quartz on one side and the other, but had not succeeded. On the top of the hill copper is found disseminated in the rock, but no vein. Mr. Randolph intended to sink upon the hill in the hopes of finding a vein. The trap is amygdaloidal, and each cavity contains on its walls epidote, while crystallized quartz, colored by epidote, fills the interior of the amygdale. The crystals are small, but the whole rock presents a very singular appearance from the lively contrast of colors. The quantity of copper obtained here, to judge by the stuff thrown out at the drift, is by far too small to allow of any hope of mining being successfully prosecuted here.

Left the mine and took the trail, descending the river to the small ware-house, about a mile from the location, and thence struck off into the woods in a NW. direction to meet the road from the location of the Ontonagon Company to the Grand Rapids. The surface being covered by deep clay banks, which has been worn into an infinity of ravines by the action of water, is exceedingly tedious to traverse. Reached the ware-house at the Grand Rapids barefooted, and with clothes nearly torn to rags, and descended the river with our boat to the mouth and camped, intending to leave for the Porcupine mountains as soon as practicable.

August 6.—Rain all day. Remained in camp. Mr. J. Bernard and party came in from the Porcupine mountains, where they had been exploring, last night, and gave me much information with regard to the region and the Montreal river district. Wrote to Dr. Jackson, giving an account of our explorations up to this date.

August 7.—Violent storm still continues, and we are unable to leave. Wrote up journal, and made sundry reparations required before leaving for the Porcupine mountains. Saw Messrs. Eaton, Randolph, and others and obtained all the information possible with regard to this country.

August 8.—To-day, the weather being fine, we started for Iron river with a Mr. Smith, whom I had hired to return to Copper Harbor with our boat to bring provisions for our party, (as we knew that we should soon be out,) our arrangements for joining Judge Burt's parties, as directed by Dr. Jackson, having been entirely defeated. Had we brought only a few days' provision with us, as originally suggested by him,* we should have all been obliged to return to Copper Harbor; by the present arrangement we shall lose no time, but shall be able to keep on our work in the Porcupine mountains. Reached Iron river at 12½ p. m., and camped at the mouth. Saw Mr. E. Tyler, agent of the Charter Oak Company, who had a map of the Porcupine mountains and Agogebic lake. In walking along the shore, found a great number of limestone pebbles containing fossils—more than at any other point of the shore which we have examined. They are evidently of the corniferous limestone. This spot has long been inhabited by a band of Indians at some

* I never made any such suggestion. I directed him to join Judge Burt's party according to my instructions. The surveyor general was to order Judge Burt to receive him.

C. T. J.

ons of the year, and they have a good trail from here to Agogebic , which is distant about twenty miles.

ugust 9.—Sent off our boat to Copper Harbor, under charge of G. E. th, and started with Mr. Tyler in his boat for Union river, distant it two and a half miles. Found a tolerable road leading from the ith of the river, which is nothing more than a small brook, to the e, distant two miles. Camped near the houses, and proceeded to mine the mine.

'his mine is on a small stream, called Union river, which furnishes at mine sufficient water-power to be used in hauling out the ore and ining the mine. Two inclined drifts have been driven in upon the ss of copper bearing rock—one on each side of the stream. They are lined about 27°; and they are now putting up a vertical water-wheel l suitable machinery for hauling out the ore by water-power. The ct depth of the working we could not ascertain, owing to the absence he agent. Two shafts have been sunk—one to each inclined drift—l drifts have been run to each side from each of these shafts. The which they are working consists mostly of chlorite, and lies between sandstone and the trap. It is four to five feet in thickness, and contains per irregularly scattered about through the mass, though, as would n from an examination of the stuff thrown out, the quantity must be r small indeed. The copper is often in folia, between the scales of chlorite, as thin as gold-leaf almost. Generally the chlorite has an 'gdaloidal structure, and is filled with amygdales of calc spar. These 'gdales contain copper on their walls, and the interior is filled with spar. All along on the under-side of the bed, next to the sandstone, chis very hard and slaty, there is a band of clay or decomposed chlo-

A good deal of copper was found here soon after opening the mine, near the surface, in masses of considerable size and of peculiar ap-ance. They are imperfectly crystallized, and the masses terminate ı finger-like projections, which have at their extremities crystalline s, though rather rudely developed. Some specimens approach nearly ıe dodecahedral form, but they are rarely perfect. As we shall revisit locality again, we did not complete our examinations at this time.

ugust 10 —Crossed a section line to clearing of Delavan Company, ınt six miles west, and which is situated in the midst of the Porcupine ıntains. Noted the geological character of the route on our section s, and measured the principal points over which we passed. Crossed ı ridge of conglomerate, and being overloaded with a heavy pack, and ral instruments, fell, and broke my barometer. Camped at the Dela-Company's, having had a fatiguing time, as we were obliged to pack ur instruments, tent, and provisions for a week or ten days, on our backs.

ugust 11.—Fine weather, though warm. Left our camp with Mr. ıard, and took the trail of the Delavan Company to Carp lake, where a ge is built across the lake. Here we discovered a dug-out, in which we arked. On the south side of the lake, about a quarter of a mile from the tern extremity, discovered diggings on the shore. Found a shaft sunk v feet in a perfectly amygdaloidal trap rock, cavities of the rock filled calc spar and zeolitic minerals. A few stains of copper on the rock ably led to excavating here. Luckily, the work was soon abandoned. he southern side of the lake, the ascent is quite gentle. The height

of the hill, which stretches along the shore, may be estimated at two to three hundred feet above the lake. It is covered with fine maples. On the north side, bold precipitous cliffs line the shore, and rise with a steep talus of angular fragments from the edge of the water. Climbed about 200 feet, on small fragments of hard red sandstone, to the base of the perpendicular face of rock, up which we climbed nearly to the summit. We found it to be sandstone, much altered and hardened by the trap, and in many places so shivered by the action of upheaval as to break into small prismatic fragments, though it still retains its slaty structure. The highest points of the bluff are 250 to 400 feet. Ascended the stream about half a mile from its outlet into the lake. Along the banks of the river grow fine pines and hackmatack, with abundance of wild roses. Landed at the houses, which are at the base of a bluff nearly 400 feet above the lake. Ascended the cliff by a zigzag road. Right on the edge of the cliff, a few feet below its highest point, is the mine, which we shall examine again, and report on fully. Made drawings, &c., to illustrate the condition of the mine, and noted geology on township plats. Returned to camp at Delavan Company's.

August 12.—Started this morning in company with Mr. Greaves, agent of the Delavan Company, to examine the ranges of the Porcupine mountains south of our camp. Took trail to workings of Croton Company diagonally across section, and found there in a small stream that a shaft had been sunk a few feet into the trap rock; near the surface considerable epidote, mixed with calc spar, across the width of the shaft, but on descending the epidote disappeared, and a large quantity of a sort of trap and sandstone breccia; the sandstone, being converted into a hard, jaspery mass, appeared. In this breccia masses of impure epidote are occasionally found. This is evidently no vein, and a few thin threads of gray sulphuret of copper which occur in the sandstone breccia, are the only inducements to mining here. Proceeded south on section line, and ascended what appeared to be the highest point of the second indistinct line or range of heights. Found a low bluff on the southern side made up of a compact red jaspery mass, which may, perhaps, be nothing more than sandstone altered by the proximity of the trap. It is exactly similar to that found on Mount Houghton. In some places, even, it still seems to retain distinct marks of stratification; in others it seems to be entirely converted into jasper. We left this hill and struck south for the fifth correction line. We then struck south for what appeared to be the highest point of the range beyond, or the third range. About one-fourth of a mile south of correction line found a considerable lake. Passing to the west of it, we found its outlet running west. We then ascended again another steep ridge, which we found to be entirely composed of the same jaspery rock. Ascended to highest point of the Porcupine mountains, which we estimate at 1,200 or 1,300 feet above Lake Superior. Returned to camp, much vexed that our barometer had been broken at so unfortunate a time.

August 13.—Left camp this morning with Mr. Greaves, and, proceeding along the trail to the bridge leading over Carp lake, took trail to left, leading to several locations along the base of the cliffs. About one mile and a half from the bridge ascended the bluffs to the base of the perpendicular trap rock, and examined several slight openings on the face of the rock where explorations have been made. In some places the trap breaks into small fragments, and between the joints stains of copper are seen, but

ng of much interest. Between the trap and sandstone, at the junc-
of the two rocks, there is a vein of clay and decomposed chlorite, but
or no copper in it. As it began to rain heavily, we returned to our
. In the afternoon we continued our explorations up the bed of the
l stream which runs across the location, to examine several openings
re they have been searching for copper on the location of the Delavan
pany. The stream falls rapidly between high rocks on both sides,
affords a good view of their nature along its channel. The rock is
cipally amygdaloidal trap, the cavities being often filled with yellow,
mposed epidote, which forms a singular rock. Massive epidote occurs
long the stream, and is evidently as much a rock as the trap itself. It
ot confined by regular walls, but runs into the trap, and is mixed with
regularly. In some places a reddish jaspery rock occurs mixed with
r and epidote. Ascended the hill a quarter of a mile, where they have
k thirty feet on a mixture of epidote and calc spar; no evidence of cop-

lugust 14.—Went along the base of the cliffs overhanging Carp river
ocation of Isle Royale Company, managed by Mr. Teague. Found
n mining in a mixture of epidote and trap. The quantity of copper in
rock is considerably greater than we have seen elsewhere on the Por-
ine mountains, but still not nearly enough to warrant much expendi-
. The epidote is very irregularly distributed through the rock, and
copper in the epidote the same. Below they are drifting into the sand-
e, to strike the trap lower down, in the expectation of finding the cop-
more abundant. Why, I know not. There is a well defined wall
ne side, which is one of the great lines of fracture of the trap, and
g which the rock has been smoothed and grooved, evidently while
rock was being elevated into its present position. On the vein which
have attempted to work, a short distance east of the present diggings,
epidote was mostly found near the wall or line of fracture on the west
. Proceeded to location of Hope Company. Ascended to the summit
ie bluffs, and had a fine view of the valley of Carp lake and river,
the bluffs west, and the high ranges on Presq'isle and Black rivers.
arming view both ways from the edge of the bluff through the valley,
Lake Superior on both sides. This is the gap seen from the Onton-
n, and all along the shore. In front are high ranges, wooded to the
mits with maple, hemlock, and red oak, and running nearly in the
e direction as the one we are now on. Descended to the edge of the
lstone, which is here about 75 feet below the edge of the cliff, and
d diggings along the line of junction of the two rocks in the same
of decomposed clayey rock as at Mendenhall's eastern location in the
upine mountains. No traces, however, of copper.

ugust 15, *Sunday*.—No work done.

ugust 16.—To-day our stock of provisions being nearly exhausted,
hoping that our boat might be at Iron river, we started along the
e towards the east. Examined the bluffs along their whole extent,
crossing over to the lake shore from the eastern location of the Isle
ale Company, determined the junction of the sandstone and trap.
were detained a short time by the rain, but proceeded on, as we
anxious to reach Iron river. Rocks on the shore of Lake Superior
ely sandstone. Measured dip near Union Company's warehouse;
18° to north, 20° east. At Mendenhall's warehouse, dips to northwest

30°. We did not find the sandstone in place between the summit of the Porcupine mountains and the lake shore, but judged, from the appearance of the numerous angular fragments heaped upon the soil, that the bed of trap, which forms the edge of the cliffs which overhang Carp lake, is not more than 500 or 600 feet. Found on arriving at Iron river that our boat had arrived, but that Judge Burt and his parties were expected on the next day.

August 17.—To-day copied maps and dried our baggage, which was wet through and injured by mildew. Examined bed of Iron river, and measured dip of slaty, dark-colored sandstone in its bed. Labelled and packed specimens.

Dip of argillaceous slaty sandstone in bed of Iron river:

¼ mile, dip north 80°, east 14°; ½ mile, north 50°, east 17°; 1 mile, south 40°, east 16°; 2 miles, south 80° east; 3 miles, south 70° east; 4 miles, south 65° east.

August 18.—This morning Mr. Barnard started for the mouth of the Ontonagon for letters. I examined the bed of Iron river as far as the first correction line. The dark slaty sandstone passes gradually into a brown coarse-grained sandstone. Its dip is very irregular, and a few veins, say ¼-inch in width, of calc spar, were the only appearances to break the monotony of the rocks. No copper is found in them.

August 19.—Expected Judge Burt to-day, and did not leave, as we had no provisions left, and could not move till our boat arrived from Copper Harbor. We found many specimens of fossils around the mouth of Iron river. Colonel Jewett and I identified most of the species as identical with those of the corniferous limestone.

August 20.—This morning we started on the trail to Agogebic lake to find Judge Burt. After proceeding about four miles, we met several parties coming in from their work, and returned with them. Judge Burt gave me much information with regard to the lines which they had recently passed over. Mr. Barnes came in about 3 p. m., and informed me that Macadebines had severely wounded himself by a blow with the axe, and that they had been obliged to leave him in the woods, about 3 miles from Lake Superior.

August 21, *Saturday*.—This morning Mr. Bernard started with our Indian to go to Macadebines, and take him a supply of provisions, and see which route would be the most favorable for bringing him out on Judge Burt's pony, that being then deemed the most feasible method of getting him out of the scrape; Mr. Barnes and myself intending to start on Monday morning with the pony, and go in to meet them as fast as possible. During the day I conversed with Judge Burt respecting the country through which his last tier of township had passed, and examined the specimens which Mr. Barnes had brought up with him. There seems to be a region of primitive rocks of considerable extent south and west of Agogebic lake. The specimens brought by Mr. B. were fine-grained mica slate, containing garnets, hornblende rock, sienite, granite, &c. The rocks do not rise into high mountains, or crop out on high rolling land, but seem to form low ridges in a swampy country, which rise only a few feet above the general level of the same. The lowness of the country deprives it of any great interest, since it will evidently be hardly possible to exactly define the limits of the rocks, or trace their lines of

tion. Mr. Owen will, perhaps, see more of this primitive region on side of the boundary line.

ugust 22, *Sunday*.—This afternoon Mr. Bernard returned, having seen wounded man. He reports that the wound was doing well, and that, hings taken into consideration, it would hardly be expedient or ad-ble to attempt to move him, and that it would be quite impossible to to him with the pony, the ground being so wet and swampy. So e remains nothing to be done but to let Kebikijiko remain with Ma-ebines, and in the mean time we must be our own packers and cooks we can find some one to help us. Judge Burt and all his men started to-day to finish their summer's work, as the next time they come up l be the last. The Judge hopes, if the weather permits, to be through the 17th or 18th of September.

lugu·t 23, *Monday*.—This morning we made up our packs and started the Union River mine, intending to finish our examinations in this nship while waiting for our boat to arrive, and till we hear again from Indians. Arrived at Union river, and camped on our old ground. r dinner I started out to explore Union river above our camp. At our p, 40 or 50 rods above the mine, the rocks crop out on the west side he stream. Hard red sandstone, not distinctly stratified, dipping to h, as near as I could judge. I followed the stream on; a few rods re, it forks. I took the larger branch, which runs in a southwest di-on, and followed it up a mile or two, but did not find a rock in place ng that distance. The banks rise on either side alternately to 50 and are clay and sand, worn in some places into "hog-backs," or e like our "Indian ridges," being only two or three feet wide on the and extending along the river for a considerable distance. On re-ing to the camp, I found Mr. Smith had arrived.

ugust 24, *Tuesday*.—This morning we all started out to examine the hern portion of this township. We took the road to location No. 44, monly called Uncle Tom Palmer's. Proceeded 2½ miles without ng a rock in place, and came upon the clearing. Proceeded to the e, where a shaft has been sunk a few feet in the red jasper rock. individual keeping the location said they required 16 drills to pene-six inches. The only inducement for attempting to mine in this est of all rocks seems to have been a seam, a couple of inches wide, l with clay and smaller fragments of the same rock, which have, aps, washed in from above. In short, this is a good specimen of t the range for mining on locations, put on at hap-hazard in the min-region, has led men to. Following down the bed of a small brook e correction line, distant from the mine only a few rods, we found ame rock all the way. We found along the correction line low bluffs g south, or nearly so, of jasper rock. We ascended a high mount-f the same, running a little north of east and south of west, as laid n on Higgins's map, and all beyond the range line half a mile, at h point we turned back, as we concluded that we had sufficient evi-e of the existence of the same red rock continuously along the correc-line. We then turned north, on the range line, and found the same , as we descended, 1½ mile from corner. At the section corner, miles north of correction line, we turned our steps east, and going t a quarter of a mile, found Carp river, which is laid down on Hig-s map as west of the range line. In the bed of the river we found

amygdaloidal trap; also about fifty rods further east, at a point north of section line. Near the quarter-post, half a mile east o line, found conglomerate, or rather breccia of sandstone, and tra for considerable distance further on, the same.

August 25, *Wednesday*.—This morning I found myself quite and unable to go out; headache and rheumatic pains. Messrs. Bern Barnes went back three miles on the section line on which we c the day before, to explore the bed of Carp river. They returned evening, having traced the limits of the conglomerate and amygd trap, and also the jasper rock. Mr. Bernard furnished a map of t sections, on which the limits of the rocks are laid down. We fi geology totally at variance with that laid down on the map furni government by Messrs. Higgins and Hubbard. Mr. Higgins the yo who executed the sectional work in their townships, told us a river that he himself knew nothing of the rocks; but that he co specimens where he found, or thought he found, rock in place, specimens were carried to Detroit, and there named by Mr. Hu who made the map in his office from information thus obtained.

August 26, *Thursday*.—To-day I was much better; but still I t it best not to do much work. The night had been very rainy, a had had heavy thunder. This morning the weather still looks ening. Messrs. Bernard and Barnes examined the bed of Union and the neighborhood of the Boston works. After dinner, the w having partially cleared up, they started to go to our Indians t them in provisions, and make such arrangements as they might necessary for leaving them, while we go on west and continue our Mr. Smith went to Iron river at the same time to bring up a furth ply of provisions, as we intend to remain here till Saturday afte He returned the same evening. Bernard and Barnes left Iron riv afternoon for our Indians, and went on as far as the first crossing.

August 27, *Friday*.—This morning, the weather being fine, I camp and went west three miles, following the section line part way and the line of locations Nos. 254 and 255, on which, at the of the two locations, we found a bluff of conglomerate some 46 height. N. B.—The mosquitoes never tormented us more tha did here. We then returned to the section line and went on t river. Proceeding up its bed, which is decidedly romantic, with and clear pools of deep water, we found amygdaloidal trap perfect characterized for about half a mile in a straight line up the which runs nearly south. Here the hard jasper rock takes its pla continues as far as the stream has laid bare the rocks. In the a loidal trap I could find no trace of copper. Returning and follow stream down from the point where we first struck it, the amygdaloi continues to be seen in places for about half a mile, when th glomerate steps in and continues as far as I followed the stream. bed of the stream much of the trap has its cavities filled with e and there is a gradual passing of the rock in many places into c epidote rock. In other places, though less frequently, the epidot placed by chlorite in the cavities; and then, again, the whole m comes chloritic, or is converted into chlorite rock. I did not d any copper in either of these minerals. Other persons, who a have explored here considerably, have probably had the same luc

lomerate cuts off the amygdaloidal trap completely, a little beyond iver, (8,) as seen on our map, and we have not seen it in place be- l. We turned our steps towards our camp about 3 o'clock, and ar- l just in time to escape drenching from a tremendous thunder storm, :h settled down into a rain which lasted all night.

ugust 28, *Saturday*.—Last night it had rained heavily, with heavy ider. This morning, the weather being tolerably fine, I examined the of Union river, and the brook on which the Boston Company have t a shaft, which they have since abandoned. Near our camp the lstone crops out in the bed of the stream, not very distinctly stratified, dipping to the north. If this is not the rock which Higgins and Hub- l have denominated red slaty trap, then I can find it nowhere. Pro- ling down the bed of the stream, we find trap a few rods above the e. Examined its junction with the sandstone, but could find nothing liar. In the trap, a short distance above the present mine, there is a e bunch of what appears to be mostly quartz, with some spar, colored in places, (query, by oxide of copper?) and what I suppose is green ate of copper. It seemed to be a sort of pocket in a narrow vein, or ere bunch, as I could trace it but a short distance. They had sunk aft on the side of the bank. After dinner packed up and returned to river, where we had hardly had time to pitch our tent, when Messrs. ard and Barnes returned, and Kebikijiko with them, for a further ply of provisions, as Macadebines is still quite unable to move.

ugust 29, *Sunday*.—This day it rained without intermission. I lay n my back in the tent all day, quite unwell. The rest of our party pretty much the same, as they were all nearly tired out. A barrel of skey had been tapped, and our Indians, with all the others, left here, some of Mr. Hale's men had kept up a drunken frolic all night— eral kakenjammer, therefore, all day.

ugust 30, *Monday*.—To-day the wind blew strongly from the NW., at our boat could not go out; weather cold and disagreeable. Our an having recovered from his drunken frolic, started to return this ning; leaving us, however, totally without help, so that we must now ur own boatmen and packers.

ugust 31, *Tuesday*.—Cloudy, but light wind from NW.; started our , and rowed against the wind as far as Mendenhall's warehouse, re we camped and dined, and remained on the lake shore waiting for lm. Sandstone all day, with patches of conglomerate dipping to NW. Shores of the lake low and swampy; abundance of fine cedar; rises lly along the back of the Porcupine mountains.

eptember 1, *Wednesday*.—This morning the wind being ahead, and strong for us to row against, we started on an excursion to the top of ill, hoping that we should be able to find the rocks exposed some- re, so that we might be able to estimate the thickness of the trap :h caps the sandstone along the brow of the cliff, bordering on Carp and river. Ascended the hill to Mendenhall's clearing, and up the to his mine. Found things pretty much as before. In the red oxide shaft the veins of spar seem to lose what little copper they first car- , and there is evidently nothing here worthy of being worked. The in the workings above between the two seams (see diagram) is euri- y shattered. The clay seam is evidently richer in copper near the ace, where it is several inches thick, and contains little bits of metallic

copper nearly oxidized through, and encrusted with carbonate and sub-oxide. From the mine we proceeded eastward on the brow of the cliff to the point where it begins to fall off. Here we had a fine view of the mountain valley through which Carp river runs, and of the conglomerate hill which cuts off the amygdaloidal trap. As the range or cliff on which we were gradually sinks, the trap falls with it, and at length disappears till it seems to re-appear at Union river, which we suppose to be the same belt of trap as that on the brow of the cliff above Carp lake. We returned along the back of the hill, hoping that we might see the rocks in place somewhere on the way. We did not, however, see anything other than blocks and boulders of sandstone, which are piled up all over the surface of the mountain. We conclude, however, that the trap is not probably more than one-quarter of a mile in width, and perhaps considerably less. Returned to our camp; and the wind having subsided, we rowed to the mouth of Carp river, distant by estimation 10 miles, and camped. The shore all day is sandstone, generally low, and wooded with cedar, birch and poplar. Passed the "lone rock" in Rocky islet, an isolated mass of sandstone a few rods across, and rising some 15 or 20 feet above the surface of the water. Near Carp river the mountain seems to fall off, and near the mouth of the river the country seems to be comparatively level. One company has a bark shanty here, intended for a warehouse—the "Atlas Mining Company." We shall examine their location on our return. Carp river, after leaving the valley of the Porcupines, must descend rapidly, as we estimate the height of the lake at 200 feet above Lake Superior.

September 2, *Thursday*.—To-day the clouds were heavy and lowering, but as we had concluded to go on to Presq'isle river, we embarked and reached our place of destination in about three hours' rowing. Rain soon commenced, and the rest of the day was too stormy to allow of anything being done. In the night it blew a gale of wind, and rained violently.

September 3, *Friday*.—Strong wind from the north, and cloudy. Started after breakfast for the clearing of the New York and Lake Superior Mining Company, on location 129, distant six miles; road cut out four miles of the way over good, level county, covered with hemlock and sugar maple. No rocks seen in place along the whole route, till we strike the river again. Red sandstone is seen about a mile from the cabin, and proceeding on we meet the conglomerate about one-quarter of a mile before reaching the clearing. At the same the rock is hard, compact trap. Thickness of the conglomerate is here little less than one-fourth of a mile. The sandstone was nearly E. and W., and dips N. 8° W. at an angle of 30°. In bed of river we found boulders of prehnite and quartz, containing a little copper. Camped near this clearing on location 149, close by the river. No mining has been done on this location, which has been *kept* for the last year by two men, probably in consequence of the highly favorable reports of the geologist employed to examine and report on it—I suppose in the intention of striking this vein; but from the rubbish thrown out, as well as from the fact that they had soon discontinued digging, I presume without success. The mass of quartz contains a small sprinkling of native copper, and might be a foot in width. Trap continues down to the mine. The specimens which they are now throwing out differ somewhat in appearance from those I had before remarked. They were like thin layers of sandstone, with thin sheets of copper compressed

ween them. It is therefore not impossible that the whole bed of chlo- may disappear as they sink. May not the copper still continue to be nd between the trap and the sandstone? It is evident that unless the antity of copper found is much more considerable than at present, the ne is of no value. They have now carried down one of their inclined afts 120 feet, and I believe that they intend expending all their force in king one above, instead of two—convinced, I presume, that unless y find better ore, their prospects are = 0. At the mine the sandstone pears in the bed of the stream, dipping nearly at about 25°, and con- ues down to the lake. Crossing over to the small brook on which the ston Company have been working, which is about one-fourth of a mile st of the Union Company, we find the same succession of rocks. The t of trap is less than one-fourth of a mile in width, and has sandstone each side of it, as in Union river. In the trap is a vein of quartz, c spar, and silicate of lime, which contains a little metallic copper. s width is from eight to ten inches; dip, 30° to 40° north. There is so epidote here in the amygdaloidal trap. The vein contains too little pper to encourage working. The trap at this place presents a curious pearance at its joints, which are filled in with red argillaceous coating hich has a high polish, so as to look almost like red oxide of titanium. t the junction of the trap with the sandstone, I could not perceive any gns of the bed of chlorite.

September 4, *Saturday*.—The day was rainy and uncomfortable, but e started out to examine up and down the river. Went down; meas- ed dip and direction of sandstone; returned and crossed the river, which here about three rods wide, and rapid, and ascended a steep clay hill the other side. Course of river here nearly E. and W It falls over ygdaloidal trap ten or fifteen feet, about two-thirds of a mile above the bin. The cavities of the trap are filled by spar and laumonite. Numer- s small veins of the same minerals were found, but nothing of any in- est or value. The trap is covered by high banks of clay and sand. the afternoon we started out south, but found not much rock exposed. e country is covered with birch, hemlock, and maple, and the soil is ep—*i. e.* sand, gravel, and clay; and we were told that there is no rock be seen anywhere between here and Black river. The ranges of hills s not high, and I found it impossible to ascertain their general direction, m the want of any commanding point from which we could overlook em.

September 5, *Sunday*.—Heavy rain all day; no observations; remained camp at Presq'isle river, at location.

September 6.—Returned to the mouth of Presq'isle river; rain all day d high wind, so that we could not move; weather cold and uncom- table.

September 7.—Gale of wind and rain; unable to move from this place day.

September 8.—Took trail on east side of the river, and ascended to ation of Charter Oak Company, distant nine miles. Noted rocks on e way on township plats. Country mostly uninteresting, and no rocks n in place, except in beds of streams. Timber mostly hemlock and ple, with cedar, ironwood, lynn, poplar, and occasional white pines. termined junction of sandstone and trap.

September 9.—Left location of Charter Oak Company for Agogebic

lake along the trap range; distance about 15 miles. An indistinctly blazed line leads from one location to the other of the Charter Oak Company, and we found considerable difficulty in preserving it. The range of trap runs in a nearly east and west direction, and rises to two or three hundred feet above the general level. There are several successions of ledges, one beyond another, and they extend along to about the centre of the township. Here the ranges break off suddenly, and there is a wide and extensive swamp directly across the line of the trap rock. Out of this swamp runs a stream of considerable size, which forms one of the feeders of Agogebic lake. On the trail, about six miles west of the lake, we passed a deserted cabin: this was also built by the Charter Oak Company. The trap of this portion of the range is much traversed by vein like masses of epidote, which occasionally, but rarely, contain a little metallic copper. Camped six miles west of Agogebic lake.

September 10.—Ice yesterday and to-day one-fourth inch thick; thermometer at sunrise 32°. Proceeded along on the trap range to Agogebic lake, and camped at location of Charter Oak Company; examined the bluffs on the location of this company; found nothing of interest. The masses of epidote are of great size; and this mineral fairly becomes a rock, and might be quarried to any extent. It is occasionally accompanied by metallic copper; but the quantity of this metal is, upon the whole, exceedingly small. There can be no encouragement for mining here, and the location is already abandoned. The views from the bluffs overlooking the lake are very fine, the whole of the lake being visible.

September 11.—Rain this morning. In the afternoon examined the trap ranges to the eastward; they are similar to those which were described yesterday. The general height of these cliffs is from two to three hundred feet above the lake. No marks of valuable veins of copper could be discovered.

September 12.—Left shanty near corner of township, went one-eighth mile to line, and thence one-half mile to township corner. Ascend high trap ridge, descend again, and cross numerous low ridges. At three miles from corner found a ledge of a remarkable porphyry—a nondescript rock composed of reddish quartz, felspar, and a greenish mineral, probably epidote. This was a low ledge, rising from a rather low and swampy ground. This ledge runs northeast and southwest. About one mile east of west corner entered a swamp, which continued to corner of township, and one mile north of corner. The ground then ascended, and we rose on to rolling maple land, with no rock in place, but evidently underlaid by trap. Camped at the cabin which was built for our wounded Indian; found that he was gone, probably to Iron river, where Mr. Barnes will probably meet him.

September 13.—This morning a flurry of snow, which lasted half an hour, admonishing us that winter was approaching. Left camp, and proceeded west 12° south, across the township, over several ranges of trap. Crossed a small lake half a mile long. At 2½ miles crossed stream on Beaver dam, then ascended on to high table land underlaid by trap, timbered by hemlock, spruce, sugar-maple, and occasionally a fine pine. Stopped at location of Charter Oak Company, on Presq'isle river. Examined bed of small stream emptying into Presq'isle river, where the rocks are finely exposed. Rock trap, amygdaloidal, and filled with laumonite in immense quantity, mixed with spar and quartz in irregular masses

d plates between joints of trap. No regular veins. Farther down trap very much broken up by innumerable veins of quartz and spar. A ide seam of rock consists of a kind breccia, of prehnite and trap, and lphuret of copper; latter in almost microscopic quantity. There is no ason for making further explorations here, as there is no promise of valble veins. The country here, which is underlaid by trap, is generally ntly rolling, and not very wet, and there is much good farming land in is township.

September 14.—Left the location and returned to the mouth of Presq'- e river—distant nine miles by trail—over a tolerably good country, ntly rolling, and occasionally somewhat wet, but generally a good rming land. Soil, a clayey loam. Found Mr. Barnes at the mouth of e river, with our wounded Indian, who had, with extraordinary powers endurance, hobbled out of the woods on his hands and knees. He is ill unable to move, except on crutches. Being out of provisions, we aited here this day for Judge Burt to come in, in order to purchase of im. Saw specimens of sulphuret of copper from the sandstone on eese's location: the sandstone is of a dark slaty kind found at Iron ver. Examined the rocks in the bed of the stream, and made sketches.

September 15.—Judge Burt came in this morning, and we purchased him the necessary provisions and started immediately for Montreal river. eavy head wind and rain, so that we made but little progress. Camped shore at Deadman's cove, distant about fifteen miles from Presq'isle ver. Sandstone here dips to NW. 65° to 70°; dip gradually increases as e approach Montreal river, indicating the proximity of the trap. The ndstone on the lake-shore is generally covered by fifteen to twenty feet ickness of sand and clay.

September 16.—Continued our voyage along the coast, with head wind d heavy rain. Camped at the mouth of the Montreal river, as we dared t leave our things, there being a number of Indians there. Sand- ne here stands almost vertical; course N. 35° E. The river falls here y to sixty feet almost perpendicularly; the fall is distinctly visible m the lake. The rocks rise around the fall to the height of one hun- ed feet, and present a very picturesque appearance. Rain continued all y. Examined rocks on the lake-shore; sandstone is in alternate bands hard material, and then soft and shaly: strata occasionally somewhat ntorted.

September 17.—Packed up what things we could carry, and left mouth the river for the cabins of the Montreal River Mining Company, distant out three miles. The trail is the great one by which the Indians of c Vieux desert and some from the head-waters of Chippewa river go to payment at La Pointe. The road passes over a high hill of conglom- te, covered with large white birch and cedar. Rain continued all day, d prevented all further explorations. Remained in the deserted cabin the company.

September 18.—Spent the whole day with Mr. Bernard in exploring the d of Montreal river, and measuring the width of the alternate beds of p and sandstone, and drew plan of these interesting alternations of k.

September 19.—The first fine weather of the season. Spent the day sketching the falls from various points, and measuring the section

across the alternating bands of trap and sandstone. Mr. Norwood, of the Wisconsin survey, passed.

September 20.—Continued explorations of river below the falls. On descending the river, we cross the same beds of trap intercalated in the sandstone, which come into view repeatedly as the river bends. The beds of trap appear to widen as they descend. The trap is both compact and amygdaloidal. The cavities in the trap are filled with a greenish mineral, the nature of which is doubtful—chlorite, calc spar, laumonite, &c. Small bunches of quartz and spar, with prehnite, are found occasionally in the trap, in which are occasionally a few specs of copper. Descending the stream, we come to conglomerate, which is finely exposed in a natural section, the river having cut through in a gorge 120 to 150 feet in height. Pebbles in conglomerate, mostly porphyry and hornblende rock, some three feet in diameter. Vein of quartz and carbonate of lime two to three inches in width through the trap, irregularly defined. In the belt of amygdaloidal trap are several parallel belts of a hard quartzose material, which I do not consider as being true veins. They are occasionally stained with copper, and also contain minute specs of native copper. A drift has been run in the side of the cliff a few feet and abandoned.

September 21.—Returned to the mouth of the river. Found a party belonging to the Wisconsin geological survey; the principals were absent. Sailed with a fair wind to Black river. Camped at the mouth of the river. Examined rocks at the entrance of the river. Black argillaceous slaty sandstone, crossed by well-defined lines of fracture from one to two feet apart, running north and south; rock dips little north of west; it extends only a short distance up the river. It is more argillaceous and finely stratified than that at the mouth of Iron and Presq'isle rivers.

September 22.—Left Black river and followed the cut out road of the Black River Mining Company six miles to their cabins. Surface of the township rolling, and in some places cut up by ravines. Soil sandy loam, with clay sub soil. Timber, hemlock principally. On location numerous ineffectual attempts at mining. There are no regular veins. Much of the trap is mixed with epidote, and amygdaloidal in its structure. To the west of the location rises a high bluff 300 feet above the river. It is composed of amygdaloidal trap capped with jasper, like the Porcupine mountain range. From the summit a grand view of the surrounding country, which to the south appears much broken; a second range appears a few miles to the southward. The general direction of the range seems to be nearly SSW.

September 23.—Went out NW. corner of township 48, range 46, one mile and a quarter. South of this corner crossed trap hill 150 to 200 feet above the general level; sudden descent, and then swampy land. Swamp nearly all the way to southern edge of township. Halt a mile south of NW. corner of township 47, range 46, crossed second range of trappean rocks and continued on trap rocks, covered mostly by fine maples for two miles; then descended again into swamp. Noticed many boulders of granite and sienite. Camped in swamp two and one-third miles south of town corner. Trap very compact, and mixed with quartzose, jaspery material.

September 24.—Rainy day. P. m., broke up camp and marched to southern corner between township 47, ranges 46 and 47. Saw no rock in place. Boulders in swamp, of trap, sandstone, and sienitic granite.

oticed of beautifully porphyritic trap. One mile from town corner, began to rise on fine maple country. One mile east of NW. cor- township 46, range 46, found granite in place, reddish colored, grained; mica in small quantity, black; felspar and quartz quite ninant. A knob rising gradually on all sides, and no rock seen near the summit.

tember 25.—Remained in camp on account of injury sustained by our party. Examined the country around. Found greenstone, or almost pure hornblende rock, alternating with the granite. The contains strings of magnetic oxide of iron. The hornblende rock ns an abundance of iron pyrites scattered through it.

tember 26.—Proceeded east from camp on town line. At one mile and from corner, crossed ledge of granite and trap. Trap at summit ap- to run east and west; height one hundred feet. At two miles, e in place, rising in low knobs; swampy and low ground between . Two miles and a half another knob of granite, then swampy d. Three miles, high knob, 75 feet, granite; steep on all sides. noble pines and spruce; one pine 16 feet in circumference. Passed aw several of these isolated knobs of granite and greenstone rising itously from the low swampy land which makes up the greater part township. It seemed impossible to define the limits of these two as they are constantly occurring together. Located all the rocks wnship plats. Discovered no signs of mineral value whatever. ed at NW. corner of township 46, range 45. Afternoon explored f camp, and despatched Mr. Bernard south on line. Found same nt succession of granite knobs and swamps. The granite is the ling rock, and generally coarse grained and contains but little mica, hat black. The color of the felspar, which is the predominating al, is reddish. The whole character of this is that of almost utter lessness. Some tracts are well wooded and dry, but the larger n of the surface is low and swampy, and covered with a dense and d undergrowth. The difficulty of exploring such a region as this rdly be exaggerated.

tember 27.—Proceeded north from town corner eleven miles, and d. Saw same recurrence of granite and hornblende rocks, which are on township plats. Where the land is not low and swampy it is and heavily timbered, by maple principally. Crossed trap region, is about two miles wide, and is mostly a fine rolling country, without egular outcrop of high bluffs, but here and there low ledges from o one hundred feet in height, extending for a short distance.

tember 28.—Left our camping ground and went one mile north of town Messrs. Bernard and Barnes went west from this point to Black or our boat. I went north six miles, and thence east one mile and , and struck trail from the mouth of Presq'isle river to location of York and Lake Superior Mining Company; thence to the mouth of ver, distant about three miles. Saw, during the whole day, not a n place, and nothing whatever of interest. Swamps alternate, with emlock ridges.

tember 29 *and* 30.—Rainy and squally. Boated to Carp river and d, waiting for fine weather to visit location of Atlas Mining Com-

This location is on Little Carp river, distant about four miles from uth, near the junction of the sandstone with the trap, which we de-

termined and marked on township plat. Rock amygdaloidal trap, and contains a great quantity of zeolitic minerals in bunches and flat plates, and mixed with epidote, crystallized quartz, and carbonate of lime and prehnite. There are no regular veins. The bunches often lie nearly horizontally in the rock. The quantity of copper is very small indeed, and there is no reason to suppose that profitable mining can be carried on here. Returned to camp at mouth of Carp river.

October 1.—Started to return to Copper Harbor, the weather being still fine, but the admonitions of Judge Burt, and others well experienced in the climate, having rendered us unwilling to remain longer than the 10th of October in this region, rowed to four miles east of Iron river and camped.

October 2.—Rowed to the Ontonagon river, and then ascended to the Grand rapids, as we wish to avail ourselves of the few remaining days of fine weather to see what progress has been made in the mining operations of that region. Camped at the warehouse of the Ontonagon Mining Co.

October 3.—Went to Cushman's, location of Ontonagon Mining Company, and found Mr. Cushman absent, and that but little had been done towards estimating the real value of the region. Appearances are, however, not at all flattering. Furnace is nearly completed, but the whole arrangement is very defective, and there will be no copper produced here. Made examinations between this location and that of the United States Company.

October 4.—Made excursion to the Ontonagon to examine the neighborhood of the place from which the famous Ontonagon copper rock was taken. Sundry attempts have been made to dig for copper in the deep clay which borders this stream. There can be no doubt that the mass of copper found here had its origin in the rock near here; but the mere fact of its having been found in the bed of the stream, can be no inducement for researches in the thick clay and sand deposites close to it.

October 5.—Returned to-day to Mosquito hall, and thence to the mouth of the river.

October 6.—Prepared for departing; but wind being ahead, did not leave.

October 7.—Left Ontonagon, and arrived at Copper Harbor on the 11th, having been detained five days near the Portage by violent gales and snow-storms. We were obliged to wait at Copper Harbor till the 31st, no boat leaving on account of the tempestuous weather. We arrived at the Sault on the 2d of November, and were again detained till the 9th. We reached Boston on the 19th of November, after a difficult and protracted journey, owing to the constant storms and wintry weather.

The following is a summary of what has been done towards developing the mineral resources of the district between Portage lake and Montreal river, whether by surface explorations, or more regular and systematic mining. The various localities are, in general, designated in their order of position, beginning at the eastern extremity of the district and proceeding westwardly.

T. 52, *R.* 34, *sections* 17 *and* 18.—*Mining Company.*

Of the extent of this company's operations I cannot speak from personal knowledge, as I have not visited the location. But little has been done, however, and the company has abandoned the location, as I have been informed.

T. 52, R. 35, section 6.—Old Settlers' Mining Company.

Nothing of consequence has been accomplished here, and the prospect successful mining at this point is so small that I did not consider it orth while to visit this location.

T. 52, R. 37, sections 35 and 36.—Algonquin Mining Company.

This is the first point in the trap range, proceeding westwardly from ortage lake, where copper has been found in any considerable quantity, nd it is here that the trap ranges begin to be characterized by that regu- rity of uplift and direction which they assume on Keweenaw point, and ear the Ontonagon river. This company has built a commodious house, arn, and storehouse on section 35, near the south line of the township, n a small branch of Fire-steel river. From this point there is a road cut ut along the town line westwardly, as far as section 31, where it strikes ff northwardly to a warehouse on Fire-steel river, about two miles from s mouth, by the course of the stream. To this point boats of consider- ble size can ascend, although the stream is somewhat obstructed by llen logs. There is a trail from this location along the town line east- rardly, for about 10 miles, when it leaves the line, and, bending to the outh, it crosses Sturgeon river and reaches the Anse in about 15 miles.

The height of the houses of this company above the level of Lake uperior, is 621.7 feet. The mining operations of this company have een confined to section 36; and they have made surface explorations at veral points along a bluff, which is about 75 feet in height, and which ns nearly in a NE. and SW. direction through the section—the steep de of the ridge facing to the NW., which is an exception to the general le with regard to the trap cliffs of this region. The trap is tolerably mpact, and much mixed with epidote.

At the first open cut, about half a mile NE. of the house, copper has en found sparingly intermixed with quartz and epidote. One fourth of mile farther on, an open cut has been excavated about 35 feet in length nd 10 feet deep; its direction is nearly N. 60° E. From this excavation considerable quantity of metallic copper has been taken, mostly inter- ixed with quartz and epidote. Nothing has been done on this location uring the past year, and we were only enabled to judge of the probable lue of the mine from the appearance of the ore thrown out and now ing on the spot. There were some large masses of nearly pure copper, nd the general average of metal in the rock was much higher than in ost of the localities of this description. It would be impossible to esti- ate the average per centage of metal on the whole rock removed; but e richer portions of the rock which had been placed together would obably have yielded from 20 to 25 per cent. of pure copper. No silver as discovered in any of the fragments at the mine. The excavation ing partially filled with water, it was difficult to decide whether appear- ces were more favorable at the slight depth to which they had pene- ted than on the surface. The epidote soon decomposes when exposed the action of the air and moisture, and the rock seems to be filled with ams of a greenish pulverulent mass, in which the copper is irregularly spersed. The width of the copper-bearing portion of the rock is ex- edingly unequal.

To judge from the amount of copper thrown out at this mine, it would seem advisable to explore this deposite of copper more thoroughly by sinking upon it to a depth of at least fifty feet. What the intentions of the company were, we were unable to learn.

This company has a rude saw-mill upon Fire-steel river, about two and a half miles south of the houses; it has never been completed. The road from the location to the warehouse is, or would be were it much travelled, almost impassable from the depth of mud, the soil being wet and clayey. The country rises gradually in going westward from the houses to the point where the road branches to the location of the Douglass Houghton Company, which is the highest point of the rolling country underlaid by trap along the road. It is 759 feet above Lake Superior. Thence the country descends gradually to the lake, without any marked features, the soil and detritus concealing the underlying rocks entirely.

T. 51, *R.* 37, *Section* 9.—*Douglass Houghton Mining Company.*

This company has four locations in this township, corresponding to sections 9, 15, 17, and 22. Section 9 lies on the northern slope of the trap range, the southeastern portion of the section being underlaid by compact trap; the northwestern half of the section is conglomerate and sandstone. The surface of this section is gently undulating and covered by a good trap soil, the principal timber being sugar-maple and lynn. There is a low ridge of trap cropping out at various points on this section, in which the explorers employed by the company have found particles of metallic copper accompanied by rose quartz, or, more properly, quartz colored by sub-oxide of copper. Loose pieces of the same veinstone, with metallic copper, were found in the bed of a tributary of Fire-steel river, which crosses this section. Nothing, however, of much importance has been discovered, and no further explorations have been made upon this section.

Section 17.

This section touches the last-mentioned one on its southwestern corner, and is similar to it in its general characters. It is, however, almost entirely underlaid by sandstone and conglomerate, the trap being confined to a very small area of the southeastern corner of the section. The same appearances of native copper and quartz have been found in the trap of this section as on section 9. Nothing of sufficient importance to justify mining operations has been found.

Sections 15 *and* 22.

The cabin built by the company, which was, however, deserted at the time of our visit to this location, is on the southwestern corner of section 15. The company have also a storehouse on the northwestern corner of section 22. There is a good road cut out from the centre of the northern line of this township to the cabin along the section line. The clearing is on rolling ground, and elevated 478 feet above the lake. The mining operations of the company have been mostly confined to this section and to the northwestern corner of it, the middle and southeastern portions being nearly level and underlaid with conglomerate and sandstone. The

rthwestern portion is broken by low ridges of trap which run a little to
e east of north and present a steep face on the southeastern side. In
e of these a drift has been run in for about 25 to 30 feet, and a consid-
able quantity of copper has been obtained. The following appearances
e seen by following along the exposed face of the bluff, which is about
) feet above the general level of the surface around. The trap, which is
dark compact variety, occasionally somewhat amygdaloidal in its struc-
re, is divided at intervals of 3 or 4 feet, though irregularly, by seams,
hich are filled principally with quartz and calcareous spar in very vary-
g thicknesses. A reference to fig. 1, plate I, will facilitate the compre-
ension of the mode in which the copper occurs at this locality and at
any others resembling it. Fig. 1 is a diagram of the surface appearance
f the rock; fig. 2 is a section of the same at right-angles to the general
ne of direction of the ridges of trap. It will be seen that the trap, when
xposed on its mural face, appears to be divided by a number of seams
hich follow the general direction of the ridge, and, of course, have
ostly a rather east and westerly direction. These seams are rarely con-
nuous for any great length, yet they may in some instances be traced for
considerable distance. It is impossible, however, to decide on the iden-
ty of any two portions of one of these seams, unless the rock is exposed
ontinuously along the whole course of them. It will be seen that the
ip of these seams is invariably with that of the rock itself—generally at
n angle of about 45°. At many points of their course they are accom-
anied by native copper, which sometimes occurs in very large masses.
uch is the case at this location.

T. 51, *R.* 37, *section* 21.—*New York and Michigan Mining Company.*

Little has been done upon this location more than a mere surface explo-
tion. A house has been built on the northwestern corner of it. There
e two well-defined steep ridges of trap crossing the line between sections
) and 21, in which several veins of metallic copper and blue carbonate of
pper are said to have been discovered by those who explored the loca-
n for the company. We found the same appearances here as at numer-
s other points on this part of the trap range, namely, epidote occurring,
assive and intermixed with the trap rock, with its usual accompani-
ent of a small amount of copper. Nothing, however, was found worthy
particular notice. The ridges of trap are generally elevated about 100
et above the general level, and the ground between the ridges is some-
nes low and swampy. A barometrical observation gave for the height
the most western ridge on this section above the lake — feet. From
s the ground descends gradually in knobby ridges to Fire-steel river,
hich crosses the line between sections 17 and 20 about equally distant
m the corners. About one-sixteenth of a mile SW. of the cabin there
a knob of trap, which is elevated 660 feet above Lake Superior. The
ction is, in general, undulating, well watered, and covered by a fine
owth of maple and a few hemlocks. The same character of surface
ntinues, the country descending gradually to the corner of sections 29,
, 31, and 32, where the ground rises in steep knobs of trap, one of
ich, on the line between sections 29 and 30, about one-eighth of a
e from the corner, was found to be 633 feet above the lake. The trap

is here amygdaloidal in its character, but no promising appearances of copper were found.

Township 50, *range* 39.

As this is an interesting township in regard to its topographical features, and one in which, perhaps, more mining and exploring has been done than in any other of this district, I will give a general description of the outlines of its geology and topography, before entering on a particular description of the several explorations and attempts at mining which have been made on it.

The Ontonagon river runs diagonally across this township, in a winding course, separating into two unequal portions. The three main branches of this stream, called respectively the east, west, and middle branches, unite in sections 27 and 28, and form a wide stream, which is much broken by rapids, and can only be ascended by boats forced up against the current by setting-poles. The banks of the river are generally of red clay, sometimes rising one hundred feet above the stream, and worn into precipitous ravines, commonly known as "hog-backs," which succeed each other many times in the course of a mile, and render travelling among them most laborious and vexatious. There are several warehouses on the river, which have been used as depots for provisions by companies engaged in mining on this township and the one next south of it: most of these have been abandoned.

The trap range enters the township at the northeastern corner, and follows a nearly NE. and SW. direction diagonally through it. On the east and west line on section 12, there are two distinct ridges: the northern, the higher of the two, is 736 feet above the lake, at the point where the line crosses it on section 12. These ridges continue tolerably distinct and nearly parallel to near the Ontonagon, where they gradually break off; and at the point where the river crosses the trap range, no rock is seen, but the river has on each side high clay banks. The terminating knobs of these ridges are conspicuous objects from a distance, and are known as "The Three Brothers." The northern and middle Brothers are the proper terminations of the two parallel ridges; the southern is a spur of the southern ridge. The height of the middle Brother above the lake is 758 feet; the other knobs and ridges on the township rise from 650 to 700 feet above the lake. From the summit of the northern ridge the ground falls off very gradually to the lake, there being no other breaks than the ravines worn by running water. South of the trap range there is a beautiful level plateau, finely timbered with maple and hemlock; then succeeds a broken and uneven country, much worn into gullies and ravines. In the beds of the streams, sandstone may be seen in place occasionally; though the bottoms are generally of red clay, and the current sluggish. West of the Ontonagon, the southern boundary of the trap seems to be near the west branch of the Ontonagon, in the bed of which sandstone may sometimes be seen, and trap is found everywhere to the north of it, and at no great distance. It was on section 31 of this township that the famous "copper rock," now at Washington, was found, in the bed of the Ontonagon. To facilitate its removal, a good road was run across to the main branch of the river on section 20, which is known as the "copper rock road." A house was built here, which is fast going to decay.

Sections 15, 16, 21, and 22 have been the principal field of mining op-

ons in this township. The Ontonagon Mining Company first made aring and built cabins on location 98, (section 16,) and explored and x shafts on this and the adjoining section. Since this a portion of the tion has been transferred to another company, called the Minnesota npany; and at the time of our visit, preparations were making to re-mence mining on a more extended scale. It was the intention of this pany to prove thoroughly the value of their deposites of copper during coming winter. We understand that a large amount of provisions and like, destined for this company, was lost on the propeller Goliath; and fear that this loss may have retarded the progress of the work. A ft was sunk by the Ontonagon Company on section 22, but was aban-ed and partly filled with water when we visited it. It was said to be ut forty feet deep. On examination of the rock thrown out, we found appearance of a regular veinstone; but, as at many othes localities, a gled mass of epidote and trap rock, with veins of quartz and calcareous r, and a little native copper. Judging from the material thrown out, appearances were not promising; and probably the mine was very perly abandoned. This is called the "Gray Sulphuret Mine;" why, were unable to determine, as we could not detect any of that ore at shaft.

The same company commenced a shaft near the northwestern corner ection 11; but it was soon abandoned. The principal shaft sunk by company was on section 16, near its east line. This shaft is sixty feet p, and is mostly in the trap, without promise of a vein or valuable al.

During the winter of 1847–'48, it was discovered that mining operations been carried on at this location many hundred years previously; by t people or nation, it seems quite impossible to decide. A series of cuts had been made along the brow of the hill, principally on sec-15, from which had been taken large quantities of rock, and probably pper. These excavations had become filled up with loose dirt and table matter; and trees of large dimensions, and evidently of very con-able age, were found growing directly over them. Large quantities one hammers, or boulders of an ovoidal shape, with a groove cut nd them near the middle, probably for the purpose of attaching a le with a withe, were found buried in the rubbish which filled these ent mines. In the principal excavation a large mass of copper, about eet in length by 3½ feet in breadth, and averaging twenty inches in ness, estimated to weigh seven tons, was met with, as represented in sketch, (fig. 4.) This mass of copper had evidently been loosened the rock in which it occurred, probably by the action of fire and en cooling, and with the aid of copper wedges and the stone ham-; and had been raised several feet above its native bed on blocks of l, which were found still remaining under it quite decayed, yet pre-ng their original form. The whole surface of the mass of copper was mered smooth by repeated blows. It would appear that, after in-ble labor, they had abandoned the original intention of raising it to surface, after having removed all the loose pieces which could be sep-d from it with help of their rude tools. Other excavations of a similar re have been traced along the edge of the hill. The appearance of ock in one of these, with a column left to support the upper wall, will en in fig. 5. The whole aspect of the excavations argues in those

who made them a higher degree of perseverance and intelligence than is exhibited by the Indians of that region at the present day. Who were the real workers of these ancient mines is a question for the antiquarian study.

From the bottom of the excavation represented in figure 4, which was covered with water at the time of our visit, so that we could not examine it, many rich and interesting specimens of native copper and silver have been taken, which we saw in the possession of the agent of the company, Mr. Knapp, at Eagle river. The specimens of silver were much larger than any which have been found before upon this district. The nature of the locality will be best seen by reference to the figure. The opening follows the general dip of the seams of trap, dipping about 52° to 55° to the north. It is seven feet ten inches across from wall to wall. On the upper wall there are three seams of laumonite, and then a space of about one foot in width of epidote and metallic copper, mixed with spar, quartz and trap rock. On the lower wall there are again three veins of laumonite, occupying a few inches in width. Between the two is a rotten fractured trap rock, with polished surfaces, (slicken-sides,) with oxide of iron and much chlorite intermixed. The whole appearance, as will be seen, is more like that of a true vein than anything we have found elsewhere. Similar appearances may be observed on other portions of the hill; the epidote and quartz being generally found along the seams of the trap, dipping with it, and having the same direction as in the Douglas Houghton location, above described. It was the intention of the company to sink a shaft on the locality where the large mass of copper was found. We should advise the running of an adit level, at a suitable distance below, into the side of the hill, for the purpose of proving the whole series of veins, as represented in figure 6. If the appearances in the shaft should prove sufficiently flattering to encourage working, an adit level will be necessary, and the expense of thoroughly proving the whole locality by an adit level, which need not be more than a few hundred feet long, would not be very great. It would be rash to pronounce an opinion upon a deposite of this kind until it has been proved. The amount of copper and silver near the surface is undoubtedly very considerable. Near the southern boundary of section 16 is another excavation, evidently the work of former generations. It is in the compact trap. A seam of rock, made up of red felspar and decomposed chlorite or epidote, is here exposed, and in it are strings and bunches of copper of considerable weight. The same variety of red felspar is found scattered about through the rock. The evidence of a valuable deposite of copper is not sufficient to justify any large expenditure.

Near the cabins of the Ontonagon Company, in the bed of a small brook, occur large masses of epidote mixed with the trap, and calcareous spar and chlorite are also abundant, filling cavities in the amygdaloidal trap and in veins and strings. A good deal of laumonite also accompanies these minerals, and generally a few particles of copper.

From the mine of the Minnesota Company a good road has been cut to the river, about two miles, and it is the intention of the company to send their copper by this way to the river, and thence to its mouth in flat-bottomed boats. A trail leads to the mouth of the Ontonagon over a country gently descending and generally not very wet or swampy.

On this section also the Rosendale Company have a cabin, and have

explored deposites of epidote with copper, specimens of which contain a considerable per centage of that metal.

On the west side of the Ontonagon, the principal explorations have been made in the northeastern corner of section 19, by Mr. Randolph. The location is now abandoned. They had drifted in about thirty feet in a northeast and southwest direction, when they found the vein, as the workmen said, cut off by a wall of hard compact trap. This locality is one of an interesting class, in which a seam in the trap completely changes the character of the rock, which then gradually shades off again as we remove from the seam, till the rock gradually recovers its former structure. This is what is commonly called a "vein with one wall." Near the seam and against it the rock is highly amygdaloidal in its structure, the cavities of the trap being filled with epidote, and delicate crystallizations, or small geodes of quartz and calcareous spar. The rock graduates off into hard, compact trap in the space of six or eight feet, and all appearance of a vein is completely lost. The quantity of copper found in this locality was very small, though some specimens contained as much as 15 or 20 per cent., finely interspersed in the rock. Copper is found disseminated in the rock at various points, but there is no appearance of a regular vein.

An attempt at mining on section 31, by the Ontonagon Company, will be alluded to in speaking of the operations of this company in the adjoining section of the next township.

Besides these explorations in the trap there have been several shafts sunk in the clay banks of the Ontonagon, in search of supposed mineral treasures, by sanguine explorers. Near the spot whence the copper rock was taken, ineffectual attempts have been made to mine in the sand and clay. A shaft has also been sunk in the conglomerate, near the edge of the trap, in section 31; and another in the banks of a small stream called ———— creek, in red clay, on section 34. These idle attempts to find copper in loose masses in the superficial deposites, however, have all been long since abandoned.

T. 50, *R.* 40, *section* 36.—*Ontonagon Mining Company.*

This company has a warehouse on the Ontonagon at the Grand Rapids, near the fifth correction line, and thence a tolerable road leads to their location on the northern half of section 36. Here several houses have been constructed, and a furnace erected in a rude and unsubstantial manner. There is also a small saw-mill on a stream about half a mile south of the principal clearing. A large number of men have been employed here at different times, and explorations have been made at various points, mostly in a vein-like mass of epidote, which may be traced from the bottom of the hill up and along the summit for a considerable distance. Its course is north 76° east, south 76° west, as nearly as it could be ascertained. This mass is nearly vertical, and is one of the largest and most regular we saw. It has, however, no perceptible walls, and on either side of the principal mass patches of the same rock may be seen gradually converted into trap. It does not continue with regularity, but loses itself in the trap entirely, and then a few feet farther on it may be seen again gradually detaching itself, and becoming tolerably pure epidote. A shaft had been sunk about half way down the hill, and a drift

run in to meet it from below; small openings are made at different points in the hill farther up the side, on the mass of epidote. The results at the time we last visited the mine, were not encouraging, as the per centage of copper on the whole mass of rock removed was very small. Some masses of considerable size had been found; one lower down the hill, at the furnace, weighed 50 pounds. The copper is diffused through the rock irregularly, generally between its joints, in a thin delicate coating, tarnished with iridescent tints. Some pieces are in thin plates, and coated with decomposed epidote, much resembling in appearance old boiler copper.

This company has also commenced explorations on section 31, T. 50, R. 39, by drifting in upon a vein-like mass of epidote with much quartz. The direction of the mass seemed to be nearly E. and W. But little was here found to encourage further proceedings.

Sections 34 *and* 35.—*United States Mining Company.*

This company has a clearing and two or three cabins near the centre of section 34. There is a road cut out in a northerly direction from this clearing to the Ontonagon, near the north line of the township. It is very wet and swampy, however, and could be used only in winter. There is also a road to Cushman's, the Ontonagon Company's location, on section 36. The soil of the country to the north of these locations is excellent, and few portions of the mineral region are better adapted for farming purposes than this. A few black oaks may be found growing on the high ridges which extend through the adjoining sections.

With regard to the mining operations of the company, little can be said. They have made an excavation of a few feet in the base of the trap cliff, which is here perhaps a hundred feet high, and have removed a singular brecciated mass of trap, mingled with epidote and quartz, the trap itself being epidotic. No copper could be found at this place. Masses of epidote may be met with, however, in the ridge at various points, and generally having an approximately E. and W direction, and in these masses a few particles of native copper can be detected by close examination. There seems, however, to be no particular spot which could safely be recommended as holding forth sufficient encouragement to justify mining.

On section 35 is a high cliff of trappean rock, made up, at least when exposed with nearly vertical walls of irregularly alternating bands or layers of amygdaloidal trap and amygdaloidal epidote rock. No mining has been done here, but surface explorations have detected particles of native copper at various points on the ridge. Nothing especially encouraging having been found here, the location has been long since abandoned.

Section 18.—*Mendenhall Company.*

Several cabins have been built on this location around a large clearing, which was planted with various kitchen vegetables, all of which thrived and produced abundantly. There is a road leading from the location to the bank of the Ontonagon, at a point about seven miles from its mouth. At the time of our visit the location had been abandoned, although during the year 1846 mining operations had been carried on there on a large scale. It is understood that about $10,000 were expended in proving the loca-

Several shafts had been sunk, and drifts run from one to the other, re were informed; we were unable to inspect them ourselves, the le works being filled with water. The deepest shaft is said to be it 100 feet in depth. The vein is in the conglomerate and altered stone, and its direction is about N. 17° W., S. 17° E. It may be rved cropping out in the bed of the small stream (Mineral creek) h runs through the location near the cabins. The gangue is calca- s spar and sulphate of baryta, in which the ore occurs mixed in very ible quantity. The ore is a gray sulphuret of copper, much mixed silica. The vein varies exceedingly in width; sometimes it is split fine threads and entirely disappears, the veinstone seeming to form a ent between the pebbles of the conglomerate. Some of the pieces of ore which lay in the office of the company, and which were evidently erved as specimens of the best which had been raised, were from four re inches in width. We were informed that but a few barrels of such had been obtained. The ore thrown out was mostly very lean, being ly spar mixed with the conglomerate, and containing a small per age of the sulphuret of copper. We were told that the shaft had been ed down to a considerable depth below where ore was found in the ; here the vein, which pitched to the west at a gradually increasing e, was underlaid by sandstone. Proceeding southwardly, the vein ently becomes poorer; and when, a few rods south of the main shaft, ner had been sunk in it, on penetrating the rock to a short distance ore disappeared, and the veins appeared to be made up of a curious ure of veins of imperfect agate and calcareous spar in an altered sand- e. The vein occurs near the junction of the conglomerate and trap and the former offers every variety of appearance, owing to the prox- and action of the igneous rock. Efforts were made to trace the vein he trap, but, we believe, without success.

th carbonate of lime and sulphate of baryta were found at this vein in r crystallized specimens. The carbonate of lime is in hemitropic ls, of considerable interest to the crystallographer, the crystals being bination of the scalend triangular dodecahedron, of a form hitherto only at a locality in Siberia. It also occurs in six-sided prisms. of the varieties of imperfect agate are of great beauty. Many fine mens are said to have been obtained here, and it is to be regretted ome of the best could not have been saved for the government col- n.

is locality is, on the whole, of considerable interest, as the intended g operations, both here and at Copper Harbor, have thrown consid- e light on the occurrence of the copper ores in the sandstone and omerate, and seem to have settled the question that veins in these are not sufficiently to be depended on to make the working of them able, and that they decrease in richness in descending upon them.

T. 49, *R.* 41, *section* 12.—*Ohio Trap Rock Company.*

e cabins of this company were at first situated in the southwest r of section 5, of township 49, range 40; but the explorations of the any having embraced several locations in the vicinity, and the place tual mining being on section 12 of township 49, range 41, cabins afterwards built at the latter place. From the clayey nature of the

soil, the roads are necessarily bad, and the transportation difficult. The trap range runs in isolated knobs and broken ridges along the northern bank of the Ontonagon, which makes pretty nearly the dividing line between the trap and the sandstone. The trap cliffs are here of considerable elevation, and face the south with a bold mural front. The mining operations are mainly confined to the upper higher portions of these bluffs, so that draining can be effected by adit levels with ease, in case mining should be systematically pursued. The heights of the most elevated points of the ridge above the Ontonagon at their base, is from 300 to 400 feet. At the time of our visit to this region in 1847, nothing had been done towards proving the nature and value of the deposite of copper on these locations, although preparations were making to that effect; and in the winter of 1847-'8 considerable progress had been made towards ascertaining the probable success of mining in this region; yet, as we conceive, not sufficient to warrant a decided opinion as to the real value of this singular deposite of metal. Dr. Gibbs visited the locality in 1848, and from his notes is extracted the following:

The general character of the rock is a compact trap, containing much epidote mixed with quartz and calcareous spar, the epidote generally assuming the form of veins intersecting the trap in different directions, perhaps chiefly north and south, or east and west. The copper is found principally in those veins which have an easterly and westerly direction. In one of these veins, which dips about 35° to the north, two shafts have been sunk, one of which was sixty and the other forty feet in depth at the time of our visit, and large quantities of epidote mixed with quartz and spar had been raised. The epidote is frequently rich in metallic copper, though, as yet, it has not been found in large masses. The copper is also disseminated, though sparingly, through the quartz, and affords specimens resembling those from the Cliff mine. The epidote is often beautifully radiated, and, when mixed with the white quartz and brilliant metallic copper, affords singular and beautiful specimens. At the bottom of the hill a drift is in progress to meet the two shafts. The hill is about 130 feet in height, and the distance to be driven is about 300 feet, following the apparent course of the vein. Other openings have been made on this location and in this hill; they all present the same general characters, namely, a vein-like mass of epidote, containing seams of quartz and calcareous spar, with particles of metallic copper. The fragments of epidote are often covered with a thin coating of carbonate of copper, evidently derived by decomposition from the metallic copper. Sometimes the decomposed epidote and earthy matter form seams in the rock, which are regarded by the miners as a rich ore. The company had twelve miners at work in August, 1848, and proposed to erect stamping mills at once for separating the copper from the rock. On the whole, the quantity of copper obtained at this locality is sufficient to justify further expenditure in proving the real nature of the deposites of this kind; though the nature of the occurrence of the metal, differing from true veins, will render the ultimate success of the operation a matter of some uncertainty. The appearance of the vein seemed, however, more promising as they descended upon it.

Section 11.—*Boston and Lake Superior Mining Company.*

The general character of the deposites of copper at this location is pre-ely similar to that last described, which is only about the fourth of a e distant, although the epidote appears not to be so rich in copper as at location of the Ohio Trap Rock Company.

Two vein like masses of epidote, mixed with quartz and spar, meet at ht-angles—the one running nearly north and south, the other east and st. Two inclined shafts have been sunk on the vein, which dips to the th about 48°. The first was about thirty, the second about sixty feet in pth. The epidote was supposed to become richer in copper in descending these shafts.

Traces of ancient mining operations have been discovered at various ints along this portion of the trap range, similar to those described as and at the Minnesota Company's location.

The American Exploring Company have built cabins on sections 11 and of this township, and also on section 9; the claims to these locations ing disputed by them. They have not carried on mining operations, wever, at either of these localities.

On section 9 a few particles of metallic copper occur, disseminated rough prehnite and quartz in amygdaloidal trap, but we found nothing rticularly worthy of notice or encouraging to the miner.

The portions of the trap range embraced in sections 6 and 7, of town-ip 49, range 40, and sections 1, 12, 2, and 11 of the adjoining town-ip to the west, seem to be richer in copper than any other portion of e trap range of the district; and it is to be hoped that energetic mining ill soon develop the real value of these deposites, which differ so much om any hitherto described It is evident that the value of these veins n be best tested by drifting into the face of the bluff from the south, us cutting successively the various deposites, which have, in general, east and west direction, and dip invariably to the north with the mass the trap rock itself. Side drifts can then be cut, as the adit level cuts e various masses of copper-bearing rock, and each can thus be much re conveniently and satisfactorily tested than by sinking a shaft from e summit of the hill, besides the advantage of being clear of the water.

The operations of the present winter will, it is hoped, decide the ques-n whether these remarkable deposites of copper can be worked with ofit—a question which can only be settled by the results of actual ex-rience, since the nature and mode of occurrence of the copper differ so tirely from anything which has been seen in any other part of the rld.

T. 51, *R.* 42, *section* 27.—*Union River Company.*

This company has made quite extensive explorations—more so than y other on the district; they are now, however, entirely abandoned, operations of the company having fully determined the fact that the ality is worthless.

This location is about two miles from the mouth of Union river, where arehouse has been built on the lake shore, on section 15. A good d leads from the warehouse to the mine, gradually rising from the lake he cabins, which are 309 feet above the lake. The rock, which may

be seen in place at numerous points along the course of the stream, is sandstone, running nearly east and west, and dipping 30° to the north. On the NW. corner of section 27, however, a dike or bed of trap, included between the sandstone, makes its appearance, and may be seen again in the bed of the stream at the location of the Boston Company, about one-fourth of a mile further east. This bed of trap appears to be about 500 or 600 feet in thickness, dipping N. 25°, W. 24°—27°.

Figure — will give an idea of the nature of the bed which has been worked here. It is a bed of amygdaloidal chlorite rock, lying between the sandstone and trap at their junction. Its thickness is about five feet; it dips about 27° with the sandstone. On this bed two inclined shafts had been sunk; at the time we saw them, one was 128 feet—the other 100 feet on the course of the bed. They were connected by a drift under the bed of the stream. Two vertical shafts were sunk to meet the inclined shafts at a short distance from the opening of the latter. The intention of the company was, to make use of the stream for hauling up the ore. On returning to the mine, during the last season, we found that a deep shaft had been sunk several rods to the north of the former ones, intended to prove the bed at a considerable depth below them. As the location had been abandoned, we had no means of ascertaining the precise depth of the works at the time they were stopped, but we were informed that the shaft was sunk about 120 feet through the sandstone and then through the bed of chlorite; the veinstone thrown out indicated but a faint appearance of copper. At the under-wall of chlorite, there is a thin seam of clayey matter and decomposed chlorite. Near the surface copper was found in or near the seam in masses of very considerable weight—pieces weighing fifty pounds or more were taken out; we could not ascertain that any of these large masses had been met with in descending. The copper occurs at this mine in a singular manner. The chlorite is amygdaloidal in its structure, the amygdales being filled with calcareous spar; and when the copper occurs, it is generally as a thin, delicate envelope around the exterior of the amygdales of spar, and sometimes interspersed through the chlorite. Even in the masses which look richest the per centage of copper is very small, since the copper is in laminæ, or films, so thin that the appearance of it is very deceptive. Much the greater part of the chlorite rock, however, contains no trace of copper at all, and, taken together, the whole bed would certainly average less than one per cent. of that metal. Some of the copper at the surface occurred crystallized in elongated, distorted crystals, as this metal sometimes occurs elsewhere.

In the bed of the stream, a few rods above the mine, is a large mass of quartzose and sparry matter in the trap, which has been explored to some extent. It is mostly quartz, colored red by sub-oxide of copper, with some chloritic substance intermixed. It contains a small sprinkling of metallic copper—nothing, however, of value.

T. 51, *R.* 42, *sections* 22 *and* 27.—*Boston Mining Company.*

But little beyond mere surface exploration has been done here. It is the same bed of trap which appears here as in Union river. In this trap there is a vein of quartz, calcareous spar, and silicate of lime, which contains a very little metallic copper sprinkled through it. Its width is

n 8 to 10 inches, and it dips from 30° to 40° north. There is also a e epidote in the amygdaloidal trap. There is far too little copper to ourage working, and the place is abandoned. The trap at this place ery much fractured, and has its seams filled with a highly-polished ey matter (slicken-sides.) At the junction of the trap with the sandne no signs of the bed of chlorite which has been worked at Union er can be perceived.

Section 32.

lear the correction-line a shaft has been sunk in the hard jasper 15 or feet deep, where it remains a monument both of persevering industry l of misdirected effort, since the difficulty of drilling and blasting the sest-grained and toughest of silicious rocks could only be equalled by absurdity of attempting to mine a seam of an inch or two in thickss in a perfectly barren rock, into which a little clay and dirt had washfrom the surface.

Township 51, *range* 43.

As this township has been the scene of a good deal of mining explora-, I will briefly describe its geological and topographical features, ore proceeding to allude to the different mining companies in particular. e township is much broken by the ranges of the Porcupine mount-, which occupy nearly the whole of it. An almost unbroken pretous cliff extends along from the centre of section 13 to section 30 gonally across the township. It is elevated at its highest point about feet above the lake, and rises in some places almost vertically, with a p talus of angular fragments of sandstone and trap at its base, nearly feet above the level of Carp lake and river, which flows at its foot. s ridge is trap protruded through between the sandstone, which is id both above and below it. The bed of trap is probably not more a few hundred feet in thickness. Parallel with this range of bluffs nds the valley of Carp lake and river. The former is elevated 483 above the level of Lake Superior. South of this valley, which is narrow, rises immediately a series of rounded heights of amygdaloitrap, which form a second range much less regular in its outline than first. Beyond this, to the south, occurs the highest range of quartzose , or red jasper, in which nothing of mineral value has been discovered. ost all the explorations on the township have been made in the first e nearest to the lake, and at the junction of the trap and the sande.

Section 14.—*Isle Royale Company.*

his locality is situated nearly at the top of the high trap bluff which looks the valley of Carp lake, and the mine is about 900 feet above lake.

reference to figure 7 will show the situation of the deposite of copwhich was sought to be worked, and which is in some respects simito that of the Union River Company, and peculiar to this region. It ike that between the sandstone and the trap rock at their junction.

The sandstone dips 30° to N., and at and below the line of junction it is much broken and hardened, apparently by the igneous action of the trap. Between the sandstone and the trap is a seam about one foot in width, of blue plastic clay and decomposed chlorite, with rounded boulders of sandstone, much altered and sparry, of from one to three or four inches in diameter. In this seam, and directly in contact with the trap rock, masses of copper were found near the surface; one of which weighed 55 pounds. As was the case with the Union river deposites, it was met with in much smaller quantities farther down on the bed. An inclined drift on the bed was carried down about 20 feet, but we could see no signs of copper at that depth. At the upper side of the drift was a thin seam of calcareous spar, varying from one to four inches, and sometimes spreading out to a foot in width; it was much mixed with trap, so as to form a sort of breccia. Several feet below the juncture of the trap and sandstone was a narrow seam of rock in the sandstone, containing a small quantity of metallic copper, much oxidized to red oxide and green carbonate. This had been explored somewhat, but the quantity of copper found was very small.

The same company have explored at a locality about a quarter of a mile west of this; also in the face of the steep cliff, where there occurs metallic copper, associated with epidote, in one of those vein-like masses of the rock which occur so frequently in this district, and which seem here to have rather a N. and S. direction; whereas, on the Ontonagon they frequently run with the formation; that is, nearly NE. and SW. The quantity of copper associated with the epidote at this place is quite small.

T. 51, *R.* 43, *sections* 27 *and* 28.—*Delavan Mining Company.*

This company has a warehouse at the lake shore on section 10, and a trail leads from thence over the trap bluff to the clearing and cabins on sections 27 and 28. There are no regular veins, or appearances of any, on either of these two localities, and it would be difficult to say what had induced any one to commence mining operations here. In the bed of the small stream which runs through the clearing, the rock mostly exposed is epidote, passing into amygdaloidal trap; the two are so intermixed that it is impossible to draw a line of separation between them. The cavities of the amygdaloidal trap are often filled with epidote, both pulverulent and crystalline, whose bright green color contrasts singularly with the dark brown of the trap itself. Sometimes the cavities are filled with crystalline quartz, and the exterior of the amygdales coated with epidote. A shaft was sunk at this locality a few feet from the trap, where it has a singularly brecciated character. It is filled with small veins of calcareous spar and zeolitic minerals, and it would be difficult to say whether it should be classed with the trap or the sandstone. A few thin streaks of gray sulphuret of copper are the only indications of metallic contents.

This location has also been abandoned. The same company have made explorations on section 21, in the trap bluff, where traces of gray sulphuret of copper have been detected.

Section 20.—*Hope Mining Company.*

No mining exploration of any consequence has been made on this location, nor are there signs of anything valuable. There is epidote in the

ff, with a few particles of native copper. The company has a ware-use at the lake shore, and a clearing with a cabin on the location.

Section 32.—Croton Mining Company.

This company has built a cabin and sunk a shaft to the depth of 60 t, in the amygdaloidal trap rock, as we were informed. The appearances much the same as at the adjoining location of the Delavan Company. ere is no vein, nor any appearance of one, at the place; and we could ect no copper in the rubbish thrown out.

Section 30.—Isle Royale Mining Company.

This company has mined pretty extensively at this location, which is the trap cliff so often mentioned, and near its western termination. veral houses were built on Carp river, communicating by a road with warehouse on the lake shore. The character of the rock is similar to it at the other location of this company on the other extremity of the p bluff. Figures 10 and 11 illustrate this. Figure 10 shows the ap-rance of an almost vertical mass of epidote running into the trap dually at both ends, and connected with it on the sides by numerous nches. The company, satisfied that there was not a sufficient per ntage of copper in the place where they were drifting, (at A,) com-nced a drift about 100 feet below, in the sandstone, which they had tended about 180 feet at the time of our visit. What the precise object the drift was it is difficult to see, and whether it was ever completed have not learned, it being soon after abandoned. The sandstone here s 25° to N. A large quantity of epidote had been quarried out, con-ning a little metallic copper with quartz; only a very small per centage, wever, of the whole mass.

In regard to all the locations on the Porcupine mountains, there can be hesitation in saying that there is no promise of a sufficient yield of pper in any one of them.

T. 49, R. 42, section —: Boyd's location.

On this location are two small cabins, and a clearing. It is approached om the Iron river trail to Agogebic lake, and is distant about six miles om that trail, a blazed line leading to it from a point about two and a half iles south of that where the trail crosses Iron river for the second time. he location lies upon the trap range, on the southern branch of it, and bout ten miles south of the fifth correction line. The trap is of the com-act greenstone variety on this portion of the range, while the northern ortion, which is separated from it by an interval of about two miles of w swampy country, is of the porphyritic quartzose variety. Near the ed of the stream, close to the eastern cabin, occurs a mass of epidotic ck, passing into trap, and containing specks of metallic copper. A nall quantity of rock has been thrown out here, but the per centage of pper which is contained in it is very small indeed. At the southeastern rner of the location, near the summit of a trap cliff 200 feet in height, curs another mass of epidotic rock which has been exposed in search of pper. This mass is about six feet in breadth by ten feet in length; it

presents superficially some of the characters of a vein, but passes gradually into the trap on both sides and above, so as to be no longer distinguishable at the distance of a few miles. A few particles of copper are found in the epidote, but appearances, on the whole, are unpromising.

About a quarter of a mile west of the cabins, near the trail, is the locality known as the "red oxide vein." At this place a small clearing has been made, and a few tons of trap rock have been thrown out in search of copper. The trap is very hard and compact, and contains epidote, and is sometimes stained by carbonate of copper. The seams of the trap are filled with thin plates of a red, crumbly substance, probably decomposed laumonite. The epidote has, as usual, some resemblance to a vein, but there is no regular vein, and no specimens of copper or oxide of copper could be found at the locality. Considerable masses have, however, been obtained from this place, being mostly native copper, encrusted with the red oxide, and rock stained and impregnated with the carbonate. The red oxide is probably an after product, from the oxidation of the native copper. Near the place is another opening of the same kind, but no copper or signs of a vein could be discovered. On the whole there is no reason to suppose that mining operations at this point would be attended with favorable results, there being no promise or appearance of a regular vein, and the copper accompanying the epidote being in too small quantity to justify further search for that metal.

T. 48, *R.* 42, *section* 6.—*Charter Oak Mining Company's location.*

This location is upon the northern shore of Agogebic lake, on the southern edge of the trap range, where it rises in a bold cliff from one hundred to two hundred feet above the lake below. Two small cabins had been built, and a considerable tract of country cleared; and preparation had been made to erect a commodious house, but the locality was deserted before the completion of it. Indeed, there is nothing upon the locality which would justify any expenditure upon it. The appearances here are the same as at many other points on the trap range in the vicinity. The trap is frequently replaced by epidote rock, which forms large masses in it, without any very definite direction or line of separation from the trap, and, as is so generally the case, the epidote is often accompanied with specks of metallic copper; but here, as elsewhere, not in sufficient quantity to warrant any expenditure in working. Nothing beyond mere surface exploration has been done on this location.

This company has also explored, at various points along the trap cliffs in township 48, range 43, where epidote occurs in large quantity, but the amount of copper found is very small; in fact, to the west of Agogebic lake and south of the Porcupine mountains, this metal has nowhere been met with but in minute particles. No large masses resembling those of the Ontonagon region occur here, neither is there any appearance of veins, regular or irregular.

T. 50, *R.* 44, *section* 17 (?).—*Atlas Mining Company.*

This company has a small warehouse at the mouth of Carp river, whence a trail leads to the location, distant about four miles. The location is upon Little Carp river, and is in the amygdaloidal trap, which

rms the continuation of the Porcupine mountain ranges, the surface being olling, and not broken by precipitous cliffs. The rocks are principally xposed in the bed of the stream, and at the time of our visit no mining perations of consequence had been accomplished, although preparations vere making to spend the coming winter in sinking upon what was conidered the most favorable of the places indicated as containing copper. There were no signs of a regular vein at the location, but great quantities f zeolitic minerals were scattered through the trap, both in the amygdaoidal cavities and also in large flat plates or sheets at irregular intervals in ie rock. The occurrence of these layers of minerals was mistaken by ose who had directed operations here as indications of the presence of regular vein; which was not the case, since these masses were entirely ndependent of each other, and scattered irregularly through the trap. The uantity of copper contained in the zeolitic minerals accompanying the ap at this point was exceedingly small, and the location has probably ng since been abandoned. The principal minerals which occur here re crystallized quartz, prehnite, datholite, and laumonite in large quanties, together with calcareous spar, which formed the larger part of the asses of foreign minerals scattered through the trap.

T. 49, *R.* 44, *section* —: *Charter Oak Mining Company.*

There is a house and clearing here on a branch of a small tributary of resq'isle river, distant by trail nine miles from the lake shore. The trap gion here is rolling and elevated, without isolated ridges. The soil is xcellent. No mining has been done, and the location has been abanoned. The rocks are principally a very amygdaloidal variety of trap, lled with an abundance of laumonite and other zeolitic minerals; also eams of quartz and calcareous spar, running in every direction through the ap, which is finely exposed in a section 100 feet in height, by the pasage of a small stream. The trap is much fractured, and the seams are lled with a clayey oxide of iron. Farther down the stream the trap is roken up by innumerable veins of calcareous spar, seeming to form a ort of breccia of these materials. A few minute particles of sulphuret of opper were all that we could discover by diligent search.

T. 49, *R.* 45, *section* —: *New York and Lake Superior Mining Company. (Location No.* 149.)

The trail to this location leads from the mouth of Presq'isle river, on he left bank, to the cabins, distant about six miles. A part of the way here is a well cut out road. The trap range is here rolling and uneven; ut the rock is not exposed in high cliffs. The river gives, however, a good ection of the junction of the trap and sandstone. The trap at the junction is hard and compact; further up the stream it is highly amygdaloidal, ccompanied, as usual, by zeolitic minerals. We found boulders of prehite and quartz, containing a few specks of native copper, in the bed of ie river. In the course of the two years, during which two persons ave been employed in exploring in this vicinity, nothing of value has een discovered, and no mining operations have been commenced, the forts of the company having been confined to the cutting of roads and e building of cabins.

The rock is rarely exposed in this region, except when cut by considerable streams of water. The surface is covered with a deep accumulation of clay and sand.

T. 48, *R.* 46, *section* 5.—*Black River Mining Company.*

A warehouse has been built by this company at the mouth of Black river, and a well cut out road leads to the clearing and houses, distant about five miles from the lake shore. The soil is good, and the aspect of the country agreeable. Explorations have been made at several points in the vicinity, and shafts have been commenced in sundry places, but entirely without success, and the location has been deservedly abandoned.

T. 48, *R.* 49, *sections* 23, 24, 25, *and* 26.—*Montreal River Mining Company.*

This company had leases of several locations of three miles square along the course of this river; but their explorations have been confined to lease No. 19, at a point about four miles, by the trail, from the mouth of the river.

In general the rocks are very little exposed in this region, except upon the lake shore and in the bed of the Montreal river, which, where the trap crosses it, has cut a deep gorge through the almost vertical strata of sandstone alternating with trap, and through the thick belt of conglomerate which flanks the trap on the northern side, exposing a fine section of the rocks. The operations of this company have been very limited, and after building a house and making a clearing, the location seems to have been abandoned, an excavation of a few feet in depth only having been dug into the river bank. The trap is both compact and amygdaloidal—generally the latter. That belt which lies nearest to the conglomerate is most decidedly amygdaloidal, and contains large quantities of the usual zeolitic minerals which occur irregularly scattered through the rock, and contain occasionally a minute trace of copper. There are numerous irregular veins of a hard quartzose material, occasionally stained with copper, occurring in this belt of the trap. Their course is nearly north 55° west, and they dip from 45° to 60°. They are very limited, and I do not consider them as affording any probable indication of valuable copper deposites. The quantity of copper they contain is exceedingly small, and it is not probable that their continuance could be depended upon.

STATISTICS

OF

THE MINES OF KEWEENAW POINT,

Compiled by Messrs. Foster and Hill.

Name of company, and situation.	Elevation above Lake Superior.	Nature of the rocks.	Nature of the vein.	Nature of th
	Feet.			
Boston and Pittsburg, *(Cliff mine.)*—Sec. 36, township 58, range 32 west.	393	Greenstone forming the top of the cliff, amygdaloid and rotten chlorite below.	The lode bears north 27° east; underlie 18° to the east; average width 18 in., and is nearly at right angles to the prolongation of the hills.	Copper, native sheets or one of whi exposed s to weigh 5 These shee quently at thickness of with little termixed; a seminated the veinston faces often ed into red and green ate, but m quently brig per-red. Sil tive, more associated v copper, bu abundant n cross-course
North American.—Section 2, township 57, range 32 west.	415	In the same range with the Cliff mine; rocks similar.	There are three veins. The width of the working vein is 3 feet, bearing north 38° west; underlie 12° to the east.	Copper, nati sheets and c nated. Silv tive, associat the copper.
Northwest.—Section 15, township 58, range 30.	666	The super-position of the rocks is this: porphyry passing into greenstone; on the summit of the hill conglomerate 12 ft., dipping to the northwest; amygdaloid where the shafts have been sunk; dark compact trap at the mouth of the adit. Conglomerate probably limits the veins on the north.	Three working veins within 200 yards of one another. 1st Stoughtenburg vein bears north 16° 35 east; 2d. Hogan, north 19° west; 3d. Kelley, north 17° 12′ east. The course of the Hogan vein intersects both of the other veins, but the work has not been prosecuted far enough to determine whether it becomes merged or cuts through. Width of 1st vein 14 inches; 2d, 20 inches; 3d, 15 inches. Underlie of the 1st 8° to the east; 2d, west 8°; 3d, west 10°.	Copper, nati sheets and d nated. One masses fro Stoughtenbur weighed 2,7 Red oxide and carbonate of c occasionally f Silver, native, ciated with the per.

compiled by Messrs. Foster and Hill.

Nature of the vein-stone.	Per cent.	Depth of shafts.	Length of galleries.	Drainage.	Number of shares.	Number of men employed.	Average monthly pay.
		Feet.	*Feet.*				
The veinstone is composed of several gangues; drusy quartz, calc spar, chlorite, and prehnite predominate.	18	215 170	1st, 275; 2d, 1,278; 3d, 408; 4th, 340.	.....	6,000	75 under ground. 65 surface.	$32 00 25 50
Calc spar, quartz, epidote, chlorite, and laumonite.	..	155	1st, 80; 2d, 164; 3d, 248.	Effected by whim worked by horse; three hours' pumping per day required.	6,000	12 miners. 8 surface.	30 00 24 00
In the Kelley vein prehnite predominates, associated with chlorite and calc spar. In the other veins calc spar predominates, associated also with chlorite and quartz.	..	Kelley vein—1st, 40; 2d, 50. Stoughtenburg vein—1st, 27; 2d, 30. Hogan vein—1st, 50; 2d, 40.	Stoughtenburg 220; Kelley, 268; Hogan, 86.	.....	2,500 1,000 unassessable.)	Temporarily suspended.	

STATEMENT—

Name of company, and situation.	Elevation above Lake Superior.	Nature of the rocks.	Nature of the vein.	Nature of the ore.
	Feet.			
Copper Falls.—Sec 11, township 58, range 31.	203	The mining ground here is amygdaloidal trap, and is probably limited to a space of 36 ft. on the surface, being bounded on the north by a stratum of conglomerate, and on the south by a belt of sandstone; after penetrating the sandstone, calc spar was observed for a distance, and then all traces of mineral disappears.	Average width of the lode 10 inches, bearing north 23° east.	Copper, native, in masses; one of which, nearly pure, weighed upwards of 12 tons; also disseminated in the veinstone. Red oxide and green carbonate occasionally found. Silver, native, associated with the copper; most abundant near the junction of the conglomerate and trap on the north, also along the west wall of the vein.
Northwestern.—Sec. 24, township 58, range 31.	593	The mining ground is similar to that of the Northwest, the porphyry, conglomerate, and amygdaloid occupying the same relative positions.	The lode is, on the average, 18 inches, but in places it expands to 4 feet, bearing north 22° 51′ west; underlie slightly to the west.	Copper, native, in thin sheets and spangles; also disseminated; also green carbonate and red oxide incrusting the surfaces. Silver, native, occasionally found, mostly on the west side of the vein.
Lake Superior, (Eagle River)—Sections 19 and 30, township 58, range 31 west.	237	Greenstone at the surface; a felspar and hornblende rock beneath; amygdaloid still below. Seen best at the upper shaft. A thin stratum of conglomerate, dipping to the northwest, a few rods below the lower shaft, with trap breccia imposed. Workings not sufficiently extensive to determine whether the conglomerate limits the vein in that direction.	The lode is from 1 to 3 feet wide, bearing north 70° west; underlie slightly to the west.	Copper, native, in spangles and sheet-like masses in the cells of the amygdaloid. Silver, native, associated with the copper; also in a peculiar red soft trap on the west wall of the vein.

Continued.

Nature of the vein-stone.	Per cent.	Depth of shafts.	Length of galleries.	Drainage.	Number of shares.	Number of men employed.	Average monthly pay.
Chlorite, prehnite, calc spar, and quartz; leonhardite and laumonite; felspar and analcime. Much of the veinstone is amygdaloidal, the cells of the rock being often filled with native copper.	..	*Feet.* Main, 130; 2d, 78; 3d, 40; 4th, 11½.	*Feet.* 1st, 496; 2d, 177; 3d, 60; 4th, 120.	Drainage effected by whim, worked by horse power; one horse works the pumps 6 hrs. in 24 to free the mine from water.	3,000	20 miners. 12 surface.	$32 00 25 00
Chlorite, calc spar, laumonite. A soft brown trap is also associated with the copper, forming the matrix.	..	38 24	362; when extended 950 ft. to the upper shaft, it will strike it at 140 feet below the surface.	.....	3,000	Temporarily suspended.	
At the upper shaft chlorite, calc spar, and quartz. In the bed of the stream the prevailing mineral is prehnite. At the lower workings the shaft was sunk on the west wall rock of the vein; the rock was amygdaloidal, and charged with copper. Laumonite, leonhardite, analcime, and felspar found.	..	1st, 15; 2d, 60; 3d, 144 75.	.....	A horse working a whim for 6 hours in 24 was required to drain the mine.	1,200 (400 unassessable.)	Temporarily suspended.	

Name of company, and situation.	Elevation above Lake Superior.	Nature of the rocks.	Nature of the vein.	Nature of the
	Feet			
Lac la Belle—Sec. 32, township 58, range 29 west.	309	Greenstone capping the Bohemian mountain, graduating into protogine, or a rock composed of fels ar and chlorite; chloritic slate at the base of the mountain, flanked by conglomerate, with sandstone resting conformably on it.	The main vein appears to be confined to the greenstone and protogine. It can be traced from the top to the base of the mountain, cutting it for 850 ft. in depth. The bearing is north 26° 53′ west, and the underlie 12° to the east, but varisble; average width 18 in. Another vein 6 in. wide, bearing south 89° west, with an underlie of 55° to the north.	Copper, gray s ret, or vitreou per; copper p also green carl of copper i form of a pu lent earth, associated, b perceptible t eye.
Bohemian—Section 29, township 58, range 29 west.	622	Same as preceding...	Same as preceding...	Same as precedi
Quincy, (*Portage Lake.*)—Sec. 26. town. 55, range 34 west.	400 estimated.	Upper wall dark brown trap; lower wall amygdaloid.	The lode bears north 43° east, and underlies 58° to the northwest; average width 8 inches. In places it contracts to 3 in., and in others expands to 16.	Copper, nativ sheets and spots. Silve tive, associated copper.
Forsyth.—Sect'n 33, town. 57, range 32 west.	554	Greenstone, hard and compact, on top of hill, amygdaloid at base. This is near the lower portion of the trap—the chlorite slate being seen in the shaft.	Lode well defined on surface, bearing N. 9° 45′ west; underlie 13° to the east.	Copper, in s weighing a hu pounds; also seminated. S native, is foun nails driven thr the masses.
Albion.—Section 11, town. 57, range 32 west.	572	Greenstone on top of cliff, amygdaloid below.	Vein 18 inches wide, bearing north 40° west; slight underlie to the east.	Copper, native small particles. ver traces.
Medora.—Sect'n 11, town. 57, range 32 west.	719	Sienite on one side, greenstone on other. Amygdaloid at base of hill, 250 feet below brow.	Lode bears north 38° east; underlie 11° to the east; average width 20 in.; well defined.	Copper, native, a of hill, sparsely seminated, sionally in bun Copper, arse sulphuret, adh to walls on the of the hill.

Continued.

Nature of the vein-stone.	Per cent.	Depth of shafts.	Length of galleries.	Drainage.	Number of shares.	Number of men employed.	Average monthly pay.
		Feet.	*Feet.*				
Calc spar, chlorite, and quartz.	..	1st, 40: 2d, 28; 3d, 36.	1st. 450; 2d, 396.	Drainage by 2 adits—1st, 27 feet above lake; 2d, 309.	10,000	4 miners. 7 surface.	$30 00 24 00
Same as preceding	..	1st, 106; 2d, 60	1st, 86; 2d, 50	Whim	3,000	Temporarily suspended.	
Calc spar, chlorite, and amygdaloid.	..	67					
Chlorite and epidote, with calc spar.	..	70	60	Whim worked by hand.	3,000	Temporarily suspended.	
Chlorite, quartz, and calc spar.	..	100	62	.....	3,500	Temporarily suspended.	
Calc spar, quartz, laumonite, and leonhardite on brow of the hill. At the base spar and chlorite, the latter predominating.	..	40	360	.....	4,500	Temporarily suspended.	

CARP RIVER, *August* 25, 1849.

SIR: As you have made a formal demand for all of the geological notes &c., taken by me while employed on the survey, I herewith furnish you with a transcript, almost verbatim, of such as remain in my possession.

Copper Harbor.—The junction of the trap and conglomerate occurs on Astor point. The line of bearing nearly due east and west; dip north 35°. At the point of contact the trap is vesicular, but a few feet distant amygdaloidal; the conglomerate made up of rounded pebbles of greenstone, porphyry, and rarely granite, pebbles varying from an eighth of an inch to eighteen inches, cemented by a dark iron sand, with carbonate of lime among the interstices; lines of stratification by no means distinct; the work traversed by numerous veins of calc spar, whose general course is at right-angles with the bearing. At Fort Wilkins, the green and blue silicate and black oxide of copper were found in the matrix.

The amygdules of the trap here are filled with quartz, chalcedony, and carnelian, forming agates, with chlorite, laumonite, the latter forming also strings or threads bearing west of north. The trap is brown and granular, and its surface occasionally exhibits a wrinkled appearance, as though it had suddenly cooled while in a liquid state. It has a pseudo-stratification, arising from the several lines of cleavage. It is doubtful whether the vein on Hays's point, and which is a continuation of that at Fort Wilkins, traverses the bed of trap. This vein is nearly four feet wide, and bears N. 19° E. The matrix is calc spar, colored in places by the green and blue silicate of copper, and is the "green rock" of the early voyageurs. A shaft was sunk on this vein to a considerable depth, but the vein showed no signs of increased productiveness, and the work was abandoned.

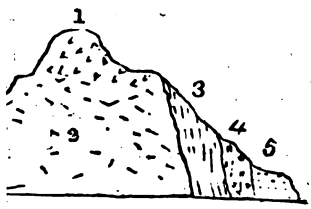
The line of junction between the upper portion of this trap bed and the conglomerate, traced on the map, from Hays's point to where it cuts the lake. Such notes as relate simply to the boundaries of the rocks, I will not transcribe.

Point below Porter's island. At the junction of the two rocks, the conglomerate for the distance of 20 feet is very much metamorphosed. It is difficult to trace the exact line of junction, the amygdaloid and conglomerate are so intermingled. The trap here contains amygdules of chlorite, agate, laumonite, leonhardite, pectolite, and occasionally smoky and amethystine quartz.

The second belt of conglomerate does not differ essentially from the first. It ranges south of L. Fanny Hoe, and rises into hills from 300 to 400 feet both east and west from this point. About four rods from the outlet of Manganese lake, there is a vein of calc spar intermixed with black oxide of manganese. The vein is three feet wide, about fifteen inches of which, where exposed, is occupied by ore. It is highly silicious, which impairs its value. The inclination of the conglomerate is 25° to the NW. The vein appears to have been subjected to a slight dislocation.

Horse-shoe harbor.—Conglomerate bears E. and W.; dip 41° N. This belt extends from Hays's point to head of K. P. Trap on shore, bearing to last appearance of the conglomerate 239° and 80° to head of Manitou island. On the Boston and L. S. location, altered sandstone seen by lake shore, less than 100 feet thick, bearing N. 10° E., dipping ∠50° northerly. At the second buildings, a belt of conglomerate, less than 12 feet wide, is

lake shore, bearing 265°*. Numerous strings of spar seen in
me of which contain traces of copper. A red jasper forms the
of the old fish-house. One fourth of a mile north of "bare
lstone observed in alternating bands of red and white. The
rs to be destitute of iron and lime, and will make an admira-
le.
t.—Jasper above, trap at the water's edge.
erate, resembling that on the northern slope, 30 feet wide; dip-
40°.
es above Sibley's landing, sandstone composed of white and
s observed, dipping easterly ∠85°. In the bottom of the bay it
admirably, and can be examined to advantage when the water
t exhibits a series of curves, conforming apparently to the Bo-
ge. I was exceedingly anxious to trace out the bearings of
s, but the party would not submit to the detention.
n mountain.—You have in your possession the section between
nd Copper Harbor. This mountain on the summit consists of
greenstone, while the base is composed of felspar and chlorite,
highly crystalline. At the base there is a rock about 150 feet thick, of a shaly structure, consisting principally of chlorite. The accompanying sketch will illustrate the order and position of the rocks at this point. 1. Greenstone. 2. Felspar and chlorite rock. 3. Slaty chlorite. 4. Conglomerate. 5. Sandstone. I observed no distinct line between the two igneous varieties of rock.†



Company.—Vein of prehnite, bearing N. 30° W., 8½ inches
traces of copper. Another string, nearly parallel, in a gorge
range.
ing the Albion location, the ground rises abruptly into a ridge,
20° E., which attains, in places, an elevation of 800 feet above
'o the southwest the ground slopes gradually, but to the south
upt cliffs from 200 to 250 feet in height. The upper portion of
s composed of firm crystalline greenstone, while the base is
al. As to mines in this ridge, also Forsyth mine, see "Sta-

er.—The west vein on this location, known as Sheffield and
inches wide, the matrix being composed of chlorite, calc spar,
nts of the wall rock. Course N. 19° W. It is in a hard
rock, but the amygdaloid probably comes in below.
e eleven belts of conglomerate between the Lake Superior
works and the lake shore. One of these beds is seen in the
w rods below the main shaft, and was passed through in drift-
rein did not become lost, but it was wholly unproductive.
Eagle river and the Portage, conglomerate commences one-

nge were taken with a prismatic compass, graduated to 360°.
itions on the veins here, vide statistics of mines.

half mile above the river, and continues beyond Silver creek, bearing E. 50° E., dip 30°. On the Hitz location, some of the calc spar veins contain sulphuret of copper. At Lake-shore location, the sandstone comes in one-fourth of a mile north of the post between sections 11 and 14, bearing N. 30° E., dip westerly ∠32°. Near the south line of township 57, range 33, the bearing is S. 15° W., dip ∠20° northerly. The sandstone makes its appearance a little more than a mile west of the Portage, bearing N. 15° E., dip 10° northwesterly. The cliff consists of red and variegated shale, with beds of compact and slaty sandstone. Beautiful flagging stones can be procured. I measured one by the shore which was $6\frac{1}{2} \times 8 \times \frac{1}{4}$ feet, perfectly flat. The stone is reddish gray, of uniform texture, stands the weather, and is sufficiently firm to resist the wear of feet. It readily breaks into blocks varying from 4 inches to 2 feet.

Portage.—The timber near the lake shore is red oak, but a few rods back the growth is open, consisting of Norway pine. Four miles east of Portage, we went in. The country rises gradually from the lake, and the growth consists of maple and cedar. About $3\frac{1}{2}$ miles from the lake the Medora Company sank a shaft through the soil, when the underlying rock was found to be sandstone. This was the only exposure of rock until we arrived at the El Dorado location, although there are evidences of trap half a mile north. At this location, which is now abandoned, the agent sank two shafts at random. (Vide map as to the position.) At the upper shaft the trap was amygdaloidal, containing numerous agates, and some specimens of copper were obtained; but neither shaft crossed any vein.

Quincy mine.—(See table.)

Sandstone and trap unite, about half a mile up a small stream, at Rankin's warehouse, bearing N. 22½° E. Between Portage lake and Eagle river, on section 36, township 46, range 33 W., the junction of trap and conglomerate occurs, and is well exposed on the west branch of Torch river. The stream is precipitated say 80 feet over a trap ledge into a deep gorge, and thence finds its way to the main river.

The conglomerate, or rather sandstone containing quartz pebbles, forms the gorge of the stream below the falls, and differs essentially from that on the northern slope of Keweenaw point. Between the sandstone and the more compact trap is a bed of red slaty trap, associated with amygdaloid about 300 feet in thickness. This rock is fissured, and the seams are filled with quartz and calc spar. The Douglass Houghton Mining Company drove an adit along the course of one of these seams to the distance of 40 feet, but met with no encouragement to prosecute the work further. The dip of these strings is about 50° to the NW.

The junction of the sandstone and trap was also observed on the southern portion of section 19; the trap occupying also the extreme NW. corner of section 20. On the SW. quarter of section 8, township 58, range 56 west, the Trap Rock Company sank a shaft to the depth of 70 feet, by a small stream crossed by the trail, then drifted 66 feet from the vein, thence sank 29 feet further, when the veinstone consisted of small strings of quarz and calc spar, and its average width was about 10 in. Chlorite was also intermixed. From it good specimens of copper were procured.

On a branch of Torch river, eight and three-quarter chains south, and from six to seven chains east of the west quarter-post, the New York and Michigan Company commenced mining operations. The junc-

of the trap and conglomerate is seen a few rods below their workings. e greatest thickness of trap above does not exceed 40 feet. I saw no ications of a vein, aside from a few calc spar seams. The rocks pre- ted a similar appearance to those at the Douglass Houghton Mining npany, on the branch of Torch river, before alluded to.

Sandstone observed in place on the section-line between five and eight, nship 56, range 32. The route from the North American mine to tage lake is through a rolling country; the rocks rarely emerging to the face. The soil, resulting partially from the decomposition of the trap, warm and rich, supporting a dense growth of timber, consisting of large ite pines, suitable for lumber, bird's-eye maple, yellow birch, and casionally elm. Spruce and cedar line the water-courses. In the cinity of Portage lake the land is level, and, when cleared, will be suf- iently dry for arable purposes.

Sandstone is also seen on the northern side of Portage lake, on a point ree-quarters of a mile above Quincy mine; bearing, same as that last scribed. No rock visible elsewhere above this point.

Lake shore.—Large angular masses of trap, with large water-worn masses granite, were observed resting on the sandstone, two miles above our mp at Porcupine river, 15 feet above lake level. Dimensions of one of e granite masses, $8 \times 5 \times 3\frac{1}{2}$. This occurs on section 5, township 5, range 33. Sandstone at the mouth of stream on the west side of sec- on 5, bearing N. $22\frac{1}{2}°$ E.; dip NW. $\angle$ 26°.

On section 33, township 57, range 33, a singular sandstone is seen, 80 ds in extent, which is composed of rounded grains of quartz and fel- ar, differing from any sedimentary rock observed by me on the lake; e bearing and dip conformable to the sandstone proper.

Sand dunes occur at short intervals between Eagle river and the coast. here are numerous evidences that the drift once extended over most of eweenaw point, but it has been abraded Patches of clay, so extensively veloped in the Ontonagon region, are observed about Portage lake.

On the township plats will be found numerous notes on the junction of e rocks, made by me, which were incorporated in the map, but which ould be of no service to you in writing your report. The table of mines rnished you last year, comprises all of the information I had at that ne with regard to them. These notes comprise all the memoranda in y possession, acquired while connected with the survey under your large. A large portion of the time was devoted to office work, such as aking plans of mines, sections, maps, &c. The notes made after the t of September have been already communicated.

Notes on Isle Royale.

The *rhomb* is varioloid trap of a grayish brown color, and pseudo- atified. A belt of conglomerate, about 12 feet in thickness, is seen on ibon and other islands, whose general course corresponds to that of e reef, and whose dip is SW. $\angle$ 12°. This conglomerate, in lithological aracters, resembles that of Keweenaw point. A thin band of calc spar also observed in several of these islands, rarely exceeding 8 inches in ickness. On the main land, by Ransom, the trap is of a dark gray lor, slightly amygdaloidal and very tough. The Union and Isle Royale mpanies' works are in this rock. The vein bears nearly east and west,

with a dip of about 45° to the NW., the matrix quartz, chlorite, and calc spar, with native copper in spangles and thin sheets. Shaw's vein and Scovill's vein, near the termination of the point or Forefinger, appear to be a continuation of this vein, the course, matrix, underlie, &c., corresponding very nearly. The columnar trap is seen on the point north of Scovill's house, at the water's edge, and appears in a cliff on the north side of the point, 30 or 40 feet in height. The prismatic structure extends from the water's edge to the brow of the cliff. In it I saw no indications of veins. It contains concretions of spheroidal masses of calc spar and jacksonite. On the southern side of Blake's point it also exhibits the columnar structure. The mass of this point, however, consists of varioloid trap, and attains an elevation of 500 feet above the lake. The Cloven Tower is of this variety. It is not unusual to meet with bands of porphyry running through this mass, like a stratified rock. These bands are composed of green felspar and hornblende, the crystals of which are large and well-defined. On these points the rocks were observed to be polished and grooved in a wonderful manner, and this process apparently extended from the water's edge to the highest points. On the north side of Blake's point the varioloid trap is seen forming cliffs 70 or 80 feet high; but at the base, a belt of amygdaloid is observed which appears to form the numerous points and islands lying northwest from this point, Locke's point, Amygdaloid island, &c. A ridge of fine crystalline greenstone approaches the shore near Miller's works, and extends thence to the head of the island. In places, however, beds of amygdaloid are seen: for example, at the outer point of Todos harbor Mr. McCulloch sunk on a spar vein in this amygdaloid, but with slight success. He also drove an adit a few feet in a vein on the main shore, which is in the greenstone, but his explorations have not been prosecuted sufficiently far to test its productiveness. The cliffs on the NW. side of the island rise up to the height of 30 or 40 feet, and exhibit numerous alternations of greenstone and porphyry, resembling in many respects a stratified rock. They are occasionally traversed by veins of calc spar, but exhibit few traces of copper. These were particularly noticed towards the head of the island and near Miller's.

Washington Harbor.—The rock here assumes a different appearance, being composed of hornblende, felspar, and chlorite. It is less firm, and has more the appearance of a metalliferous rock. Phelps's island contains several veins, one of which is of considerable promise. Its course is north and south, with a dip of 78° to the north. The width of the vein is 30 inches wide, and the gangue consists of prehnite, laumonite, and calc spar, with spangles of native copper. The main shore exhibits no traces of rock. The conglomerate is first observed in place on the southern point of Washington Harbor, bearing NE., and dipping SE. This rock is exposed at intervals along the coast as far as the most easterly islands of Siskawit bay. We did not determine the exact point of junction on the main shore. Between these islands and Rock Harbor the coast is lined with trap rocks, which are cut by powerful fissures, rarely metalliferous. At Epidote they have mined a bed of that material containing copper. This bed, in position and bearing, corresponds to the conglomerate bands of Keweenaw point. Seams of datholite are observed to traverse the rocks containing copper, but they want the continuity of a vein. At Conglomerate bay a band of conglomerate is seen on

north side, 15 feet in thickness, ranging with the course of the island dipping about 6° to the SE. There are evidences of other belts, they were not traced out. The section of the rocks made by me oss the island has been furnished you. As the island was not sur-ed at the time, it was found impossible to *locate* the rocks as observed ng the shore.

n conclusion, I have only to remark, that, after the termination of the l labors for that season, I informed you that I would, if you desired, te out my notes on Isle Royale, and pass them over to you. You re-d, "It is of no consequence—I have seen everything you have." connexion terminated that season after my return to New England, l was resumed the following June. More than eighteen months psed before our connexion terminated; and yet, during that period I ver heard you speak of my furnishing you notes on Isle Royale. It s altogether an afterthought; and I now furnish them not from any se of obligation, but for the purpose of depriving you of all pretexts making further communications to the Secretary of the Interior with gard to me.

Your obedient servant,

J. W. FOSTER.

Dr. C. T. Jackson,
United States Geologist, Boston.

P. S.—As I remarked to you in a former communication, I do not sh you to publish the notes which I have communicated. You are at fect liberty to avail yourself of the information.

Instructions to J. W. Foster, Esq., Assistant Geologist.

Copper Harbor, *August* 30, 1848.

From Keweenaw bay you will trace the sandstone rocks and ascertain ir position and geological age. Your journey will be in a southeast-y direction to the Peshakeme river, and along the course of that stream. u will explore the geology of the townships along its course, and, as as practicable, will extend your geology into the interior, and will ticularly explore and examine the veins and beds of *iron ore*, and rch for veins of copper, lead, silver, or other metalliferous ores. You ll search for the anticlinal axis, which probably exists somewhere hin the district assigned you. You will, if such anticlinal axis is nd, note very particularly the line of bearing of the range in which it sts, and will note the dips and direction of the stratified rocks, and rk the same on ground plans and sections. You will observe the order l succession of the rocks, and compare them with those on the oppo-e side of that anticlinal axis, noting on the spot the order of the strata, , and direction, and the thickness of the strata and beds. You will, reaching the iron ore districts, note the width of the beds or veins of n ore, and the course they pursue, and their length, so far as can be ertained.

You will take your canoes to the Menomonee river at the most conve-nt portage, and will follow that river to Green Bay, exploring the town-

ships on the east side of the river as far as practicable, and ascertain the nature and position of the rocks, the veins and beds of any metalliferous ores that may occur. You will note the character of the soil, and the kinds of forest trees you may observe, and will collect specimens of the soils from over each rock formation on such places as offer remarkable peculiarities. On reaching Green Bay, you will explore the country between the Menomonee and the Esconawba rivers, and note the kind of rocks on your way, and make all the mineralogical explorations that may be deemed useful to the survey. You will ascertain the geological age of the *limestone* rocks near the Esconawba, and collect specimens of all the fossils you may find. You will particularly examine the relative positions of the sandstone and conglomerate rocks with regard to the limestone, and thus endeavor to fix the geological age of the sandstone and conglomerate. You will collect at least two good specimens of each rock and mineral found in the district assigned you, and will mark on the labels the township, range, and section in which they occur, describing the places as minutely as possible, so as to aid others in finding them.

It is desirable that the height of the land where the waters divide and run on the one side into Lake Superior, and on the other into Lake Michigan, should be measured; and that a section should be drawn representing the heights of the places you travel over, and the nature, order, and position of the rocks.

You will take one of my barometers, and make the required observations for this section.

Great confidence is felt in your faithful execution of this difficult but interesting survey, and you are authorized to judge for yourself, in a great measure, how far it may be necessary to vary from these instructions. You will be assisted in this duty by S. W. Hill, esq., the surveyor, who will render efficient service in the explorations with which you are charged. You will take with you two of the *voyageurs* now in our employ, and may hire as many others as may be required for the transportation of your various articles of luggage, and the specimens you may collect.

On the completion of this survey, you will write to me immediately, giving an outline of the work, that I may report the same to the honorable Secretary of the Treasury. You will probably arrive at Green Bay somewhere about the last of the month, and you will probably desire to work until the 10th October.

Your return to Boston should not be delayed beyond the 20th or 25th of October, for a hasty sketch of your labors will be required in the synopsis I shall have to report to government by the 1st of November. You will be expected to draw up a report of the district assigned you, addressing your report to me.

Wishing you a prosperous journey and many fine discoveries, I have the honor to be your friend and servant,

CHARLES T. JACKSON, *U. S. G.*

s on the Geology and Topography of portions of the country adjacent Lakes Superior and Michigan, in the Chippewa land district: by J. /. Foster, late Assistant United States Geologist.

BOSTON, *May* 26, 1849.

R: In compliance with the instructions of the Secretary of the Inte- dated May 18, 1849, I embrace the earliest opportunity to communi- to you, in detail, such notes and observations touching the geology ie Chippewa land district, bordering on Lake Superior, as were made ne during my connexion with the survey while under your charge. 'hat connexion first commenced on the 18th of July, 1847, and the l operations terminated on the 14th of September following. The :rval between those periods was employed in circumnavigating Isle ;ale, and in making a section from Rock Harbor to Fish Island. Aside from the section, most of this work was done in your company, l such observations as were made by me were communicated to you bally at the time. You have also in your possession all of the sections, :tches of scenery, &c., executed by me during this period. . resumed my connexion with the survey in June, 1848. Mr. S. W. l and myself executed a geological map of Keweenaw point, giving limits of the stratified and unstratified rocks, the bearing, inclination, ., of the sedimentary deposites, and the position of all the working and ndoned mines. We also made accurate plans of the mines, principally pared from surveys executed by him while disconnected with the ps. We also made several geological sections across Keweenaw point, of which materials have been passed over to you. You have also a able of mines," compiled by us, showing the situation and elevation every working mine, the nature of the wall-rock, character of the vein- ne, the underlie and bearing of the veins, kind of ore, per centage, pth of shafts, length of adits, method of drainage, amount of ore sed, number of shares of stock, and the number of men employed. I do not know that upon these points I have any additional informa- n to communicate.

)n the 2d of September I left, in company with Mr. Hill, to explore country lying between Lake Superior and Green Bay. I present you ious notes of our observations.

The section is withheld for the reason that I purpose, during the present son, to revise it, and am anxious that it should be as accurate as sible.

J. W. FOSTER,
Late Assistant United States Geologist.

'o Dr. C. T. JACKSON.

METAMORPHIC ROCKS.

'his class of rocks is largely developed in this region. Near the head Keweenaw bay (section 25, township 51, range 33) we first meet with slates. The following section, taken at L'Anse, will illustrate the re-)n between the sandstones and metamorphic rocks:

. Fissile sandstone, containing mica, coarse-grained and red, six feet.

2. Conglomerate, containing pebbles of white quartz, with occasional pebbles of hornblende and greenstone, seven feet. These beds dip slightly to the northwest.

3. Chlorite slate, novaculite, or silicious slate, much contorted, and lying *unconformably* beneath the sandstones, twenty feet.

A short distance above, towards the head of the bay, the trap rocks are seen projecting above the water, with the slates folded over them. These slates exhibit, in a marked degree, what have been termed planes of division, or lamination, so that it requires much care to distinguish them from the lines of stratification.

The slates near the place where the section was taken are of various colors, so that the contortions are prominently exhibited. The trap rocks are traversed by veins of pure white quartz, which occasionally extend into the slates.

At the saw mill, near the mouth of Fall river, the slates were observed presenting the same wave-like structure. At this point they were chloritic, but a mile up the stream they became argillaceous, and probably will be found suitable for roofing.

In township 50, range 32, the rocks exposed were rarely in place; but, from the loose fragments scattered over the surface, it was evident that we were passing over slates similar to those before described.

In the bed of Fall river, about one-half of a mile north of the south line of township 50, we found rocks in place, consisting of chlorite slate, the lines of stratification nearly obliterated, and compact hornblende. These rocks were traversed by veins of quartz, containing iron and copper pyrites. As we approach the granite range the rocks exhibit, in a more marked degree, the effects of metamorphism, becoming less stratified and more crystalline.

A mile and a half south of the town line before referred to, we saw well-characterized gneiss, which we inferred rested immediately on the granite. The order of succession there observed on the northern slope of the first axis, was as follows:

1. Gneiss. 2. Hornblende, compact. 3. Chlorite and argillaceous slates.

The junction of the metamorphic and granitic rocks on the southern slope, which occurs on the northern side of the chain of lakes in township 48, range 31, section 21, exhibited the following arrangement:

1. Granite, made up of the ternary compound of quartz, felspar, and mica.

2. Quartz and felspar, passing into compact quartz, the granular structure and lines of stratification nearly obliterated.

3. Hornblende, compact, and breaking with a conchoidal fracture, with lines of stratification.

4. Magnetic iron ore (fer. oxydulé,) associated with hornblende and argillaceous slates, and containing seams or laminæ of saccharoidal quartz.

The iron ore was observed on the northwest quarter of section 20, dipping south 78°. It is highly magnetic, forming extensive beds, in sufficient purity in places to be wrought.

Portions of this ore are so highly magnetic as to reverse the needle. removed several rods from the mass.

In passing through a narrow gorge which forms the bed of the stream connecting the second and third lakes, (S. 21, T. 48, R. 31,) we observed that the needle was deflected towards the south; when opposite a particu-

point, the poles were reversed, the north pointing south; as we receded
: needle gradually resumed its former position. The iron was asso-
ted with hornblende, similar to that before described.
In passing over portage No. 1, numerous blocks of slate and specular
n were observed loose on the surface, but the soil effectually concealed
e subjacent rock.
Indications of iron were abundant on the north shore of Machi-gummi,
d on portions of the south shore. The ore contained considerable silex,
much so as to render most of it comparatively worthless. The range
unding the lake on the north bears nearly east and west, and is com-
sed of hornblende and argillaceous slates. The latter often present
rinkled surfaces. Associated with the hornblende are beds of quartz,
which we failed to detect any metallic substances. The numerous
nical islands in the Machi-gummi are composed of hornblende in which
e divisional planes are quite as conspicuous as the lines of stratification.
After leaving the lake, we saw no exposure of the rocks until we ar-
ved at the north part of township 46, ranges 29 and 30. The river here
rms a lake-like expansion, and is bounded on the northeast by a range
hills which rises abruptly to the height of nearly two hundred feet
ove the water.
We explored this ridge on section 1, township 46, range 30, and found
at it was composed, for the most part, of nearly pure specular oxide of
n, (fer. oligisté.) It shoots up in a perpendicular cliff, one hundred
d thirteen feet in height, so pure that it is difficult to determine its
neral associations.
We passed along the base of this cliff for more than a quarter of a mile,
king for some gap through which we might pass and gain the summit.
length, after much toil, and by clambering from one point to another,
succeeded. Passing along the brow of the cliff, forty feet, the mass
s comparatively pure; then succeeded a bed of quartz composed of
nded grains, with small specks of iron disseminated, and large rounded
sses of the same material enclosed, constituting a conglomerate. This
l was fifteen feet in thickness, and was succeeded again by specular
n, exposed in places to the width of one hundred feet, but the soil and
es prevented our determining its entire width. This one cliff contains
n sufficient to supply the world for ages, yet we saw neither its length
r its width, but only an outline of the mass. Its bearing could not be
curately determined, but was inferred to be north of west and south of
st, with a northerly dip of 85°. When we examined it, the rain de-
nded in torrents, and so dense were the clouds that the position of the
n in the heavens was a matter of conjecture. A compass was of little
ail in ascertaining the meridian. Seams of quartz were observed, asso-
ted with this bed, containing lamillar oxide of iron, nearly pure. This
n is composed of minute shining scales of a steel-gray color, and is
bly magnetic Portions of it contain silex, while other portions are
re. It is deposited in layers like argillaceous slate, and the lines of
ratification are distinct. A continuation of this iron was observed at
rtage No. 4, but the stage of the water was such that we were unable
examine it minutely. There can be no doubt that this iron ore is but
continuation of that of Carp river. Its mineralogical characters and
ological associations are the same. Its western limits have not been
termined; but its range east and west, so far as observed, is not far from

forty miles. Its extent north and south, along the line of this section, is more than fifty miles. Portions of this area are occupied by granite rocks, while others are covered over with drift; but enough iron ore has already been discovered to warrant the assertion, that the supply is inexhaustible. In the subdivision of some of these townships, during the past summer, under the direction of Mr. John Burt, deputy surveyor, I was informed by him that several other valuable beds were discovered. Among others he mentioned a bed of considerable thickness as occurring on the north boundary line of township 43, range 31. This was the lowest point where he observed it. There is an extensive bed near the Twin falls on the Menomonee, which will be described in a subsequent part of this report.

These beds, so far as I have observed, present a marked similarity in mineralogical characters, and derive their origin from common causes, and those were *aqueous*. The jointed structure and waved stratification of some of the beds prove that *igneous* causes have operated, since their deposite, to modify and change their character.

The veins of magnetic and specular oxide in the granite which have fallen under my observation are narrow and of little value, although the metal is found in great purity. But let us resume the general geology of the region.

On section 31, township 46, range 29, we observed a compact hornblende rock of a dark brown color, and highly crystalline in its structure. The lines of stratification were nearly obliterated, indicating that we were in the vicinity of the igneous formations. On the adjoining section (No. 5, T. 46, R. 21) we found another range of granite, through which the river has excavated a channel at portage No. 5.

Passing over this granite belt, the hornblende rocks again make their appearance in the north part of township 44, range 30.

A short distance below the mouth of Fence river, (T. 44, R. 31, S. 27 and 28,) we found an extensive bed of saccharoidal limestone or marble, of a flesh red color, inclining to bluish or ash-gray, and susceptible of a high polish. It appears in the form of a cliff thirty feet high, bearing northeast and southwest, and dipping southeasterly at an angle of 36°.

It contains in places seams and bunches of quartz. It nowhere exhibits any traces of organic remains, and its geological age places it below the palæozoic rocks. Three-fourths of a mile below, on the left bank of the river, it is again exposed, bearing north 48° east, and dipping nearly vertically, with a bed of argillaceous slate resting conformably on it.

This bed is nearly a mile in width, and will prove valuable as a flux in smelting the ores, aside from its uses as an ornamental stone.

The argillaceous slates are exposed for about half a mile below the mouth of Night-watching river, so highly indurated that the lines of stratification are nearly destroyed, whilst the divisional planes are very conspicuous.

Mr. Burt informed us that on the north line of T. 43, R. 31, he found a bed of iron of considerable thickness; but we were unable to ascertain where it crossed the river, owing to the accumulation of drift. At portage No. 7, a short distance below the township line, the slate forms a ridge from 150 to 200 feet high, through which the river has cut its way. In external characters it differs but little from that last described, having

its fissile character by long continued exposure to heat. The ring of the rocks was found to be northeast and southwest, with a h southerly dip.

Between the 7th and 8th portages the rocks consisted of alternating ds of argillaceous and hornblende slates. At portage No. 8 the hornnde slates are finely exposed, bearing north 80° east, and dipping rly vertically. They were finely crystalline in texture, very fissile, l of a dark brown color. The hornblende rocks continue to portage 9, in the south part of T. 42, R. 31. Here the granite has proded through the incumbent strata, forming an anticlinal axis, bearing rly east and west. Hornblende flanked the granite on either side, d to this succeeded mica slate, followed by a repetition of hornblende te, the northern slope corresponding to the southern. This is exbited within a space of about two miles. The mica slate was observed be finely laminated and striated on the surfaces.

At portage No. 10, 1½ mile below, the mica slate again occurs dipping ° southerly, and bearing nearly east and west.

At the falls of the Machi-gamig the rock is hornblende slate, forming high ridge, bearing N. 72° W., and dipping southeast at an angle of 69°.

At portage No. 1, on the Menomonee, about a mile below the junction the Brulé and Machi-gamig, the rocks consist of alternating beds of rnblende and argillaceous slates, nearly conforming in dip and bearing the slates at the falls. At portage No. 2, near the south line of townip 41, range 30, occurs a high ridge of argillaceous slate, containing ygdules of calc spar, and presenting a porphyritic appearance. The aring taken, N. 70° E., dip 75° S.

Between this point and the upper of the Twin falls the argillaceous d chlorite slates largely predominate, and traverse the country in sharp, oken ridges.

At the upper falls they present a good section, bearing N. 80° E., and pping 80° southerly. Associated with them are beds and seams of artz, containing iron and copper pyrites; but the latter was not suffiently abundant to prove of any economical value. The slates here are ne grained and dark colored, and do not readily absorb moisture. A od article for roofing purposes might be obtained by quarrying beyond e action of the atmosphere. At the lower falls, which occur within a ile, the slates form cliffs seventy feet in height, dipping nearly ver:ally.

Here I found an angular block of quartz, bearing on its surface a series ripple-marks, as regular and beautiful as the flutings of a Corinthian lumn.—(See plate 1, fig. 2.) The interior appeared compact and ystalline throughout.

It is questioned even at this day whether some of the rocks, such as mpact quartz and saccharoidal limestone, which occur in this series, d a chemical or mechanical origin. Yet, here is a rock which, whilst interior has every appearance of having resulted from chemical changes, ars on its surface indubitable marks of aqueous origin. In the quartz ks lying contiguous to the granite, and where the lines of stratifica-n were hardly discernible, I have readily detected the granular struce, clearly indicating its mechanical origin.

About two miles southeast of the lower falls, near S. 30, T. 40, R. 30, re is a large bed of specular iron ore associated with the talcose and

argillaceous slates. It makes its appearance on the north side of a lak and can be traced a mile and a half in length, and in places is expos one hundred feet in width. It bears nearly east and west, and in e ternal characters resembles that of the Iron mountain before describ This bed was first discovered by John Jacobs, from whom I derived the i formation, and may be regarded as the southern limit of the iron. The dis tance from this point to the most northerly point where iron was observed, is more than 50 miles in a direct line. Below the falls there are heav accumulations of drift, so that the subjacent rocks are rarely seen; and thi bed of iron ore, if it cross the river, is effectually concealed.

Near the mouth of Muskos river, in the bed of the Menomonee, we ob served large angular blocks of compact limestone, 20 feet in length an 10 in thickness. It was of an ash gray color, inclining to green. Nume rou blocks were observed for half a mile below the point where first obse ved. Their magnitude and angularity, and the fact, too, that no rock of a mi lar character had been observed above, either detached or in place led us to believe that they had slidden from the adjacent hills. We exp lored the adjoining ridges with a view of finding the bed from which they were derived, but without success. The only rock exposed was ma ssive hornblende. I have, however, so great confidence in the existence of bed of marble in this vicinity, that I have inserted it in the section.

The Great Bekuenesec falls occur in the northwest part of tow n 39, range 30. From this point, proceeding southerly, to the mou t Pike river, distant thirty miles, we find a series of igneous rocks, e posed of porphyries and close-grained basalts protruded among the rocks, tilting them up vertically, and forcing portions of the bed asunder. The mineralogical characters of these rocks will be par larly described in another chapter. At the foot of the falls a bed o cose slate, of a light drab color, is seen, about forty feet in thick bearing north 70° west, with a southerly dip of 84°.

At the foot of Little Bekuenesec falls another patch of drab col slate was observed, thirty feet in width, succeeded by a fine-grained ing slate, bearing nearly east and west, with a dip of 80° to the so Near the falls is a vein of quartz, red felspar and chlorite, bearing n west and about 18 inches wide. It contained magnetic oxide of iro octahedral crystals, copper pyrites in dodecahedrous and iron py The copper was not in sufficient abundance to justify mining explora The slates below the falls line the bank of the river, forming hills hundred feet in height.

The next point where the slates were observed was at the foot of S geon falls, near the south boundary of township 39, range 29. T were argillaceous, and wedged out between the enclosing walls of sien The mass was about 40 feet thick, and near the falls was traversed b vein of quartz, magnesian limestone, and chlorite, containing trace green carbonate of copper.

After passing a few miles beyond Sturgeon falls, the slates do not ag make their appearance until we arrive at Chippewa island, the inter being occupied by igneous rocks. Here the sandstone, trap, and sla are seen in proximity, and the section appended (see plate 1, figure will illustrate their relative positions.

a. Drift, resting on the sandstone, with angular fragments of rock and fragments of the blue limestone, containing organic remains.

b. Sandstone, coarse grained, with little adhesion between the particles, composed of alternating layers of red and white, dipping less than 20° to the southeast.

c. Dark colored basalt, occasionally porphyritic.

d. Argillaceous and talcose slates, nearly vertical and finely lamellar.

At the immediate point of contact between the slates and the basalts the lines of stratification were destroyed, and the slates were converted into clinkstones.

It thus appears, that whilst the slates have been subject to violent distortions and alterations by the protrusion of the igneous rocks, the sandstone has been quietly deposited on their basset edges, and that from the time of its deposition to the present day there has been no exposure to long continued heat, to change its structure—no eruption of lava currents, fracture its strata; but that the elevatory movement by which it was raised to its present position must have been a gradual one.

The slates are so contorted that all attempts to estimate their thickness prove merely approximative; and it may be that the same beds are repeated many times. They are exposed along the line of the section for more than a hundred miles, after deducting the spaces occupied by the trappean bosses, and the space occupied by the overlying sandstone, having for the most part, nearly a vertical inclination. Were we to measure them at their basset edges, as is customary, and assume that as their aggregate thickness, the result would be incredible.

The immense and almost unprecedented deposites of specular oxide of iron, forming hills, constitute an important *rock* in this system. Some of our best American geologists have been disposed to class them as veins instead of beds.*

But they certainly bear upon their surfaces strong marks of their metallic origin. They are regularly stratified, and often contain thin layers of silex in minute grains, so that a specimen, on its cross fracture, resembles ribbon-jasper. The lines of stratification can readily be distinguished from those of lamination. Like the slates, they are often found curved and wrinkled, and the same facts could be adduced in both cases to prove their common origin.

These beds, however, are traversed by veins of quartz, at nearly right-angles to their veering, containing lamellar oxide of iron, and having all of the characters of a true vein.

Iron pyrites is commonly associated with this ore in other portions of the world, but here few traces of it were observed.

The geological position of the specular oxide of iron is the same as that of St. Lawrence and Jefferson counties, in New York. There they are included among the rocks lying between the granite and Potsdam sandstone. Here, too, we find that the inferior sandstone—the equivalent of the Potsdam—limits their upward range.

The celebrated mine on the island of Elba, which was wrought more than three thousand years ago by the Romans, is of this character. The rock with which the ore is associated consists of a white, slaty talc, containing silex, alumina, and magnesia.

The famous Iron mountain and Pilot knob in Missouri† present many

* See Professor Emmons on the iron ores of St. Lawrence and Jefferson counties, New York Geological Reports.

† The reader is referred to an article of much interest on the Missouri iron, in one of the Nos. of the American Journal of Science, by Mr. J. T. Hodge.

geological points of resemblance to this region. The ores are the same, and both bear about the same relation to the oldest rocks which form the crust of the earth. In range and extent, however, the Lake Superior iron region surpasses that of Missouri or New York, and its accessibility is by no means so difficult as is generally supposed. The outlet for these ores should be through Bay de Noquet, on Lake Michigan. The construction of a road is entirely practicable, whether it be a railway or macadamized road. Abundant materials exist along the route, and by seeking a southern outlet the navigation would be open two or three weeks earlier in the spring, and the expense of transportation around the falls of St. Mary's river be avoided.

IGNEOUS ROCKS.

Passing over to the south shore, we find a granite range in the vicinity of Riviere du Mort, or Dead river, and another forming the Huron mountains, which extend from thence, westerly, in nearly parallel ridges, and lose themselves in Wisconsin. We first observed the granite, on the line of the section, about two miles south of the north boundary of township 49, range 33, exposed in a cliff thirty feet high, forming the summit of a ridge 1,064 feet above Lake Superior.

It was of a light gray color, and composed of an infinite number of small crystalline plates, confusedly aggregated, in which could be recognised the three constituents, quartz, felspar, and mica.

In descending the ridge, the granite is seen in low cliffs on the left of the trail. Beyond the range line it again appears, forming mural escarpments, fifteen or twenty feet in height, traversed by numerous divisional planes.

At the outlet of a small lake, which is one of the reservoirs of Sturgeon river, near the east part of township 49, range 33, the rock takes into its composition a large amount of hornblende, which is arranged in crystalline plates and gives the mass a somewhat stratified appearance, like gneiss. Granite was seen at short intervals as far as the centre of township 49. Here we ascended an abrupt ridge, three hundred feet above the general level, which appeared to be composed of red felspar, containing veins of quartz and chlorite, without any traces of metallic ores.

Well-characterized sienite occurs where the north line of township 48, range 32, crosses the trail.

The highest elevation attained by this granite axis, on the line of the section, is 1,198 feet, and this is found in the north part of township 48, range 32.

On the north side of Sagiagans, (township 48, range 21, section 17,) granite cliffs are exposed in a ridge which rises two hundred feet above the water level, at the base of which are numerous large detached blocks. This is the southern limit of this belt, and here the metamorphic rocks are seen in proximity, dipping at a high angle from it. The entire width of this range is not less than ten miles.

At the head of portage No. 5, in the northern part of township 43, range 29, we struck the granite belt, which nowhere attains any considerable elevation. The rock is made up of the binary compound of quartz and felspar, in large crystals, and often passes into the variety called graphic granite. The amount of drift spread over this region prevented our fur-

he southern limit of this range, but it was believed to occur near the ıern boundary of township 44, range 29. This would give it a width out six miles.

portage No. 9, indications of granite were observed, which induced Hill to explore the ridge with much minuteness. He found granite pying the extreme summit, bearing east and west, and about half a in width. Over this mass the mica and hornblende slates were d, presenting on either side the same order of superposition. A ite range runs nearly parallel to the Menomonee river, in townships nd 40, ranges 30 and 31, crossing the great Bekuenesec falls, above the Muskos river. It is here associated with the old porphy- bearing northwest and southeast. On either side the range is ed by hornblende highly crystalline, which appears to belong to the ous rather than the metamorphic rocks.

SANDSTONES.

he sandstones of Lake Superior I am disposed to regard as resting at base of all the fossiliferous rocks, corresponding in this respect with observations of Messrs. Murchinson and Verneuil in Russia and den. The unbedded traps of Keweenaw point and Isle Royale have en through these sandstones, forming continuous lines of elevation. e is seen of this sandstone on Isle Royale, except on the outermost of the south shore of the island. Between this station and Kewee- point it describes an immense curve, which forms the bed of the

ıssing over to Keweenaw point, the sandstone makes its appearance about le above the Portage, in bold cliffs by the lake shore Its bearing is N. E., with a northwesterly inclination of 10°. It is of a reddish-gray color, somewhat fissile. Interstratified with it are beds of red and green e. Portions of the cliffs crumble beneath the action of the surf more ily than others, so that the beds possessing the greatest degree of in- ıtion project over like cornices. Other portions resemble ranges of k-work, while the bases of the cliffs are excavated at short intervals arched caverns, resembling gothic windows. Cliffs of this kind, ıg to the height of sixty or a hundred feet, are not unusual—some- ıs presenting a walled face, again scooped out into deep recesses, with ıerous fountains falling from the top, which in the clear sunlight flash burnished silver. The rains descending from above have excavated) grooves in the face of the cliffs, so that they resemble castles and es. These cliffs may be regarded as a miniature representation of Pictured rocks. Approaching the head of Keweenaw point, the sand- e is occasionally seen in low reefs along the beach, as far as the Lake- ·e location, where it disappears in the lake. As we recede from the , its inclination diminishes rapidly, as will be seen by the following ı, taken at different points:

ection 11, township	37,	range 33,	bearing N. 30° E.,	dip 32°	NNW.
33,	57,	33,	N. 15 E.,	20	"
6,	56,	33,	N. 15 E.,	19	"
29,	56,	34,	N. 25 E.,	10	"

When examined five or six miles from its line of junction with the trap, found to be nearly horizontal.

On section 33, township 57, range 33, by the lake shore, there is a regular bed of sandstone, eighty rods in width, composed of sub-crystalline particles of quartz and felspar. It bears N. 22½° E., with a NNW. inclination of 26°. The junction between the trap and sandstone on the northern slope of Keweenaw point is extremely difficult to determine, in consequence of the amount of loose materials scattered over the surface. The country rises gradually, and is traversed by numerous ravines, but the sandstone is rarely exposed.

The southern junction is more clearly defined; but the conglomerate which is found in such heavy masses on the northern slope, is almost entirely wanting.

Section 36, township 56, range 33, belonging to the Douglass Houghton Mining Company, affords a good exposure of the rocks. The west fork of Torch river is here precipitated over a cliff of trap eighty feet in height, near the junction, and thence winds along through a deep gorge which it has excavated in the sandstone. The sandstone is of a light yellow color, and contains numerous pebbles, consisting for the most part of white quartz. It dips southerly, or away from the trap. On the north side of the stream, it is seen resting on the trap in large blocks, seventy feet above its bed. The sandstone is seen in the banks of this branch of Torch river at short intervals, and contains greenish patches, giving it a somewhat variegated appearance.

On the south side of Keweenaw point, (section 27, township 58, range 28, near the meander-post between sections 27 and 28,) above Bete du Gris bay, sandstone is to be seen, bearing N. 22½° E., and dipping southerly, or away from the trap, for a distance of nearly three-fourths of a mile. It is white and granular, destitute of pebbles, and nearly so of iron.

On section 36, township 58, range 29, it is again seen on the shore of the lake for the sixth of a mile, abutting against a bed of brick-red conglomerate. Course N. 45° E., dip 76° SE. This conglomerate band, about twenty-five feet thick, is identical in lithological characters with those on the northern slope of the axis, and laps on the chlorite rock. The same band is seen on the Lac la Belle location, but beyond this point we have not been able to trace it. The sandstone here consists of alternating bands of red and yellowish silex, with no trace of lime.

In the bottom of the bay, at this point, when the water is calm, the buff and red bands can be seen, describing immense curves, parallel to the direction of the Bohemian range of mountains, and affording conclusive evidence that their bearing and upheaval are due to the protrusion of the igneous rocks. This is a point of great geological interest, inasmuch as it enables us to fix the relative age of the trap range and of the bedded trap and conglomerate.

On the east side of section 14, township 59, range 29, the sandstone is again seen, forming the southern shore of Bete du Gris bay. Although removed but a few miles from the trap, it is nearly horizontal. The rock is very fissile, some of the layers yellow or buff, while others are brick-red. It contains numerous concretions of dove-colored clay and red ochre, hydrous peroxide of iron.

There are also numerous concretions resembling the vertebræ or joints of the crinoids, the mould being replaced by pure white silex, while most of them contain in the centre a dark speck corresponding to the internal cavity or alimentary canal.

utting through one of these concretions at right angles to the lines of ification, it is found to be a sphere or ball enveloping the dark speck ch served as the original nucleus.

etween this point and L'Anse the sandstone recurs at short intervals, ning headlands and cliffs along the lake shore for miles in extent, so cipitous and bold, that it is impossible to effect a landing with a boat. e beds are nearly horizontal, or present a series of gentle undulations. t Tobacco river the sandstone is finely exposed in bold cliffs, and con- s of alternating beds of buff and red color, resembling the curved ds seen in the bottom of Bete du Gris bay. Some of these beds are nular and closely cemented, while others are slaty.

The aboriginal name of this river is Wasa-Kodewabikag-Lepi, or Burnt ne river, so called from the brick-red color of some of the sandstone s, while the English name is derived from the dark color of its waters, plied by numerous swamps skirting the base of the Bohemian mount- s. Here, too, we observed concretions similar to those before de- bed.

s we approach L'Anse, the dips of the sandstone to the northwest ome perceptible, and a change is noticed in its external characters. s coarser grained, with a red tinge, and contains pebbles of white rtz, and occasionally of greenstone.

t Crebessas (section 25, township 51, range 33) its course was found e NE. and SW., its inclination 28° to the NW.

n describing the slates we gave a section of the rocks, showing the tion which they bore to the sandstone. By referring to that section it be seen that the sandstone rests unconformably on them, and that peculiarly folded stratification was communicated to them before its osition.—(Plate I, figure 1.)

his was the last appearance of sandstone *in situ* on the northern e of the granite axis between the waters of Superior and Michigan, ough we met with outliers of this rock six hundred feet above Ke- naw bay.

Ve here pass over an interval of more than eighty miles, occupied by igneous and metamorphic formations previously described. In the thern part of township 37, range 28, a short distance below Chippewa nd, on the Menomonee river, we struck a sandstone bearing the same tion to the slates as that of Keweenaw bay.

While the slates are seen standing vertically with the trap, intercalated he form of dikes, the latter is deposited nearly horizontally on the up- ed edges. The greatest dip that could be obtained was 3° southerly. s sandstone consists of alternating beds of red and pure white sili- s sand, and, for the most part, the adhesion between the grains is so ht in fresh specimens that it can be crushed in the hand; but after ing parted with the water disseminated through its pores, it acquires a siderable degree of adhesion, and is little acted on by atmospheric nts. It corresponds in lithological characters to the sandstone de- bed by Drs. Owen and Locke as resting at the base of the silurian stones of Iowa and Wisconsin, and to that described by Mr. Feather- haugh as occurring in the vicinity of the falls of St. Anthony. This opposes little resistance to the erosive action of water, and conse- ntly rarely appears above the surface. To trace its boundaries, there- , is a work of much difficulty.

t the White Rapids it forms the bed of the river, with a slight inclina-

tion to the south. It is made up of bands of pure white sandstone, some of which are four feet in thickness, with thin bands of red. The sandstone appears for the last time in the banks of the stream at the first rapids above the Big Bend, in township 35, range 29; it therefore forms a belt about fourteen miles in width.

This sandstone exhibits no traces of organic remains. I am disposed to regard it as the equivalent of that lying on the northern slope of the peninsula, although it differs somewhat in external characters. These differences can be accounted for by the different degrees of pressure or heat to which the beds were subjected at different points in the process of consolidation. Besides, it is idle to expect that rocks will maintain uniformity of character over widely-extended areas. This sandstone, supposing it to be identical, attains a greater thickness on the northern slope than on the southern; and the absence of pebbles in the last described deposites indicates that the transporting power of the current diminished as it advanced southward.

Compact limestone.—At the head of the Grand Rapids occurs a light gray magnesia limestone, composed of an infinite number of small crystalline plates closely aggregated. It contains numerous geodes, lined with drusy quartz and rhomb spar.

Further down the rapids, on the Wisconsin side, it appears, forming a cliff fifteen feet in height. Here it is less crystalline, being composed of minute grains. Imbedded with it is a stratum of fine-grained sandstone, tinged red by the peroxide of iron, which effervesces freely with acids. The rapids, more than a mile in extent, are over this rock, but it is difficult to obtain a good exposure.

The limestone again appears at Caulkins's saw-mill, sixteen miles above the mouth of the river. Portions of it are made up of rounded grains of quartz cemented by calcareous matter, giving it a volitic appearance. It is also seen at the mills of Hall and Spaides, four miles from the mouth of the Menomonee, in the bed of the river. It is somewhat crystalline, more fissile than at the other localities described, and of a dingy color. Here we noticed, for the first time, traces of fossils, consisting exclusively of the disjointed vertebræ of crinoids, not exceeding the sixteenth of an inch in diameter.

Particular beds of this limestone might be called calciferous sandstone, but they nowhere expand to such a thickness as would justify their being ranked as a distinct member of the silurian system.

The width of this subdivision is about twenty four miles, the bearing northeast and southwest.

Dr. Owen, in his report of last year, remarks that he has obtained ample evidence that this limestone, like the Cliff, is a lead-bearing rock.

While at Green Bay I saw specimens of lead, said to have been procured from this rock, a short distance up the Pesetego river. As this rock must be developed somewhat extensively in the upper peninsula of Michigan, it is not improbable that lead may sooner or later be added to the mineral products of this region.

Blue limestone and marls.—This subdivision of the silurian system, according to Dr. Locke, is seen with its characteristic fossils on the west side of great Bay du Noquet. It also is seen four miles below Navarino, the head of Green Bay. A line drawn between these two points would be nearly parallel to the line of bearing, and bring the junction between the compact and blue limestones in the bed of the bay. At the latter

e rock is of a light blue color, of a granular texture, and richly ith the characteristic fossils.

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between Keweenaw Bay and Lake Michigan, as determined by barometer.

	Feet.
3 miles from head of the bay	150
of the ridge, 6 miles	448
Do 6½ miles	533
Do 7½ miles	649
ıth line of township 50, range 33	851
outh of township 50, range 33	907
south of township 50, range 33	1065
ıge line, two miles south of north line of township 49, 33	964
ıge line, three miles south of north line of township 49, 33	947
ı southeast of range line, by small lake	1031
y meadow, near where trail strikes stream	1129
ne of township 48, range 32	1113
rom township line, (summit)	1199
Sturgeon river	1073
ns, head of Machi-gamig	1049
second portage	1015
third portage	976
of Iron Knob, (section 1, township 46, range 30)	1110
fourth portage	924
fifth portage	836
sixth portage	718

DEAR SIR: I send you a list of barometrical observations, which I wish you would h culated as soon as possible. Mr. Hill I see neglected, in some cases, to take a morni evening observation. I desire that the results may be forwarded as soon as obtained, as be ready in a day or two to construct the profile of my route. I am laboring under a cold, the result of being in confined rooms.

Yours, truly, J. W. FOST

Dr. C. T JACKSON, *U. S. G. Survey.*

Barometrical observations.

Date.	Time.	Barometer.	Thermometer, attached—Fahr.	Thermometer, detached—Cent.	Hei
September 12.....	*a* 9.45	29.664	53	12½	298
	b 1.20	29.350	54	13½	383
	c 1.45	29.266	56	14½	499
	d 2.20	29.142	55	14	701
	e	.....	.....	.....	.....
	f 3	28.998	55	14	756
	g 3.40	28 874	55	14	.....
	y 4.10	28.708	54	13½	908
Camp.....	*h* 5.15	28.796	48	10	807
Sept. 13—same station as *h*.	*i* 6.35 a. m.	28.726	38	4½	797
	j 7.30	28.766	46	9	880
	k 8.20	28.684	48	10	971
	l 1.45 p. m.	28.616	57	15	962
	m 2.30	28.628	56	14½	1048
	n 3.50	28.540	56	14½	923
	o 5	28.668	56	14½	899
Sept. 14—same station as last.	*p* 8.20 a. m.	28.242	56	14½	.....
Sept. 15—same station..	*q* 6.45	28.634	.....	3½	874
	r 10.35	28.652	.....	12	.....
Same station—evening..	.....	28.400	.....	12	.....
Sept. 18—same station Cen.....	*s* 6 a. m.	28.450	8½ / 46.9	8	840
	t 9.25	28.500	11	11	811
	u 10.15	28 530	11	10½	.....

Barometrical observations—Continued.

Date.	Time.	Barometer.	Thermometer, attached.	Thermometer, detached.	Height.
nber 19.....	(1) 7 a. m.	28.450	10	9	
	(2)	28.492	9	8½	
	(3) 10.45	28.500	11	11½	
	(4) 11	28.318	10	10	
	(5) 1.50	28.510	10	10	
	(6) 6 p. m.	28.586	7	7	
20—station same	(7) 6.30 a. m.	28.600	5	4½	
	(8) 8	28.650	{ 6 / 44.6 }	5½	
	(9) 11.40	28.700	8	8	
	(10) 2.30	28.736	9	9	
nber 21.....	(11) 6 a. m.	28.984	1	1	
	(12)	.....	.....	.....	
	(13) 3.40	29.120	9	9	
	(14) 4.40	29.140	7	7	
	(15) 6	29.268	.....	.....	
nber 22.....	(16) 9.30	29.286	7	7	
	(17) 11.30	29.294	12	12	
	(18) 11.30	29.339	12	12	
	(19) 3.30	29.318	13½	13½	
	(20) 4.25	29.323	11	10	
23—camp.....	(21)	29.244	11	11	
	(22) 12 m.	29.210	16	16	
24, 1848—morn-	(23)	29.325	10	10	
	(24)	29.448	9	9	
	(25) 2.30	29.448	13½	13½	
	(26) 4.15	29.481	13½	13½	
25—same station	(27) 6	29.300	1	1	
	8.15	29.272	8	8	
		29.364	8	8	
	(28)	29.546	13	13	
nber 25.....	(29) 6 a. m.	29.720	1	1	
	(30) 1 p. m.	29.800	15	15	
27—same station	7 a. m.	29.864	8½	8½	
29—same station	8.20 a. m	29.416	5	5	
	12 m.	29.159	8	8	

Barometrical calculations.

	B.	T.	
(3.)	28.5 — .22 = 28.28	51.8	
(4.)	28.318 — .22 = 28.098	50	
		B. 1.8	A
Log. (4) 28.098			1.4
B. = 1°.8			0.(
			1.4
Log. (3) 28.28			1.4
R			0.(
Log. R			7.4
Lat.			9.9
A. 102.7			4.7
			2.2

171.51 feet ascending.

(4.)	28.318 — .22 = 28.098	50	
(5.)	28.510 — .22 = 28.29	50	
		B. = 0	
Log. (4) 28.098			1.4
B. = 0. Log. (5) 28.29			1.4
R			0.(
Log. R			7.4
Lat.			9.9
A. = 100°			4.7
			2.9

165.56 feet descending.

(5.)	28.51 — .22 = 28.29	50	
(6.)	28.586 — .22 = 28.366	44.6	
		B. 5°.4	A
Log. (5) 28.29			1.4
B. = 5°.4			9.9
			1.4
Log. (6) 28.366			1.4
R			0.(
Log. R			7.1
Lat.			9.9
A. 94.6			4.7
			1.9

87.874 feet descending.

(7.)	28.6 — .22 = 28.38	41	
(8.)	28.65 — .22 = 28.43	44.6	
		B. = 3.6	A

[illegible]. (7) 28.38	1.4530124
3.6	0.0001561
	1.4531685
[illegible]. (8) 28.43	1.4537769
	0.0006084
[illegible]. R	6 7841892
[illegible]	9.9998775
82	4.7892451
	1.5733118

37.437 feet descending.

[illegible]) 28.65 — .22 = 28.43	44.6	41.9
[illegible]) 28.7 — .22 = 28.48	46.4	46.4
	B. 1.8	A. 88.3

[illegible]. (8) 28.43	1.4531685
= 1°.8	0.0000782
	1.4532467
[illegible]. (9) 28.48	1.4545400
	0.0012933
[illegible]. R	7.1116993
[illegible]	9.9998775
88.3	4.7922152
	1.9037920

89.13 feet descending.

[illegible]) 28.7 — .22 = 28.48	46.4	46.4
D.) 28.736 — .22 = 28.516	48.2	48.2
	B. = 1.8	A. = 94.6

[illegible]. (9) 28.48	1.4545400
= 1°.8	0.0000782
	1.4546182
[illegible]. (10) 28.516	1.4550886
	0.0004704
[illegible]. R	6.6724673
[illegible]	9.9998775
88.3	4.7922152
	1.4645600

29.145 feet descending.

September 21.—Here I see no observation between 6 a. m. and 3.40 p. m.: and these differ [illegible] .136; which difference is scarcely greater than took place at Copper Harbor, with the stationary barometer. But as you at this date are beyond the height of land between the two points of observation, I shall calculate the observations without correction.

[illegible].) 28.984 — .22 = 28.764	33.8	33.8
[illegible].) 29.12 — .22 = 28.90	48.2	48.2
	B. 14.4	A. 82.0

Log. (11) 28.764..... 1.4
B. = 14.4..... .0

1.45
Log. (13) 28.9..... 1.46

R..... 0.00

Log. R..... 7.15
Lat..... 9.99
A. 82..... 4.78

1.94

87.6 feet descending.

(13.) 29.12 — .22 = 28.90..... 48.2
(14.) 29.14 — .22 = 28.92..... 44.6

B. 3.6 A.

Log. (13) 28.9..... 1.46
B. = 3.6..... .06

1.46
Log. (14) 28.92..... 1.46

R..... 0.00

Log. R..... 6.15
Lat..... 9.99
A. 92.8..... 4.79

0.95

8.99 feet descending.

No. 15 has no thermometrical observations; nor does it differ, to any great extent, fro
others. I thought of omitting, but, on the whole, will calculate it, taking 7 as the Centigra

(14.) 29.14 — .22 = 28.92..... 44.6
(15.) 29.268 — .22 = 29.048..... 44.6

B. = 0 A.

Log. (14) 28.92..... 1.46
B. = 0. Log. (15) 29.048..... 1.46

R..... 0.00

Log. R..... 7.28
Lat..... 9.99
A. 89.2..... 4.79

2.07

118.94 feet descending.

Was the morning (9 o'clock) observation of September 22 where the one of the evenin
fore was taken? Cannot connect them properly.

(16.) 29.286 — .22 = 29.066..... 44.6
(17.) 29.294 — .22 = 29.074..... 53.6

B. = 9° A.

66 ..... 1.4633853
..... 0.0003907

1.4637760
074..... 1.4635048

..... 0.0002712

..... 6.4332897
..... 9.9998775
..... 4.7968422

1.2300094

Cannot tell whether ascending or descending, on account of the corrections for

— .22 = 29.074..... 53.6 53.6
— .22 = 29.119..... 53.6 53.6

B. = 0 A. 107.2

074..... 1.4635048
(18) 29.119..... 1.4641765

..... 0.0006717

..... 6.8271753
..... 9.9998775
..... 4.8010062

1.6280590

scending.

— .22 = 29.119..... 53.6 53.6
— .22 = 29.098..... 56.3 56.3

B. 2.7 A. 109.9

098..... 1.4638631
..... 9.9999058

19..... 1.4637689
1.4641765

..... 0.0004076

..... 6.6102342
..... 9.9998775
..... 4.8021844

1.4122961

cending.

— .22 = 29.098..... 56.3 56.3
— .22 = 29.103..... 51.8 50

B. 4.5 A. 106.3

..... 1.4638631
..... 9.9998045

1.4636676
03..... 1.4639378

... . 0.0002702

..... 6.4316853
..... 9.9998775
..... 4.8005813

1.2321541

escending.

(21.) 29.244 — .22 = 29.02..... 51.8
(22.) 29.21 — .22 = 28.99..... 60.8

B. 9.0 A. 1

Log. (22) 28.99..... 1.46
B. = 9..... 9.99

1.46
Log. (21) 29.02..... 1.46

R..... 0.00

Log. R..... 6.93
Lat..... 9.99
A. 112.6..... 4.80

1.72

53.425 feet ascending.

How are the observations of September 23 to be connected with those of the 24th? Did encamp at noon of 23d? The first two of the 24th are apparently taken at different stations accordingly I calculate them.

(23.) 29.325 — .22 = 29.105..... 50
(24.) 29.448 — .22 = 29.228..... 48.2

B. 1.8 A.

Log. (23) 29.105..... 1.46
B. = 1.8..... 9.99

1.46
Log. (24) 29.228..... 1.46

R..... 0.00

Log. R..... 7.97
Lat..... 9.99
A. 98.2..... 4.79

2.071

117.95 feet descending.

(24.) 29.448 — .22 = 29.228..... 48.2
(25.) 29.448 — .22 = 29.228..... 56.3
Not difference enough to calculate.

(25.) 29.448 — .22 = 29.228..... 56.3
(26.) 29.481 — .22 = 29.261..... 56.3

B. = 0 A.

Log. (25) 29.228..... 1.46
B. = 0. Log. (26) 29.261..... 1.46

R..... 0.00

Log. R..... 6.69
Lat..... 9.99
A. 112.6..... 4.80

1.49

31.163 feet descending.

Why, after (27,) are not the next two numbered? Are they at the same station? they are:

— .22 = 29.08	33.8	33.8
— .22 = 29.052	46.4	46.4
	B. 12.6	A. 80.2
.052		1.4631760
		9.9994527
		1.4626287
.08		1.4635944
		0.0009657
		6.9848422
		9.9998775
		4.7883923
		1.7731120

ascending.

— .22 = 29.052	46.4	46.4
— .22 = 29.144	46.4	46.4
	B. = 0	A. 92.8
		1.4631760
29.144		1.4645492
		0.0013732
		7.1377338
		9.9998775
		4.7943240
		1.9319353

lescending.

— .22 = 29.144	46.4	46.4
— .22 = 29.326	55.4	55.4
	B. 9.	A. 101.8
		1.4645492
		0.0003907
		1.4649399
326		1.4672528
		0.0023129
		7.3641569
		9.9998775
		4.7985125
		2.1625469

escending.

l data for any further calculations. I beg you to look these over closely, as I can a careful use of the data given me.

A. W. THAYER.

	Centigrade Th.								Farenheit.
a	12½	× 9	=	112½	÷ 5	=	22.5	+ 32	= 54.5.
b	13½	× 9	=	121½	÷ 5	=	24.3	+ 32	= 56.3.
c	14½	× 9	=	130.5	÷ 5	=	26.1	+ 32	= 58.1.
d	14	× 9	=	126.	÷ 5	=	25.2	+ 32	= 57.2.
f	Do.								
g	Do.								
y	13½	× 9	=	120	÷ 5	=	24	+ 32	= 56
h	10	× 9	=	90	÷ 5	=	18	+ 32	= 50
i	4½	× 9	=	40.5	÷ 5	=	8.1	+ 32	= 40.1.
j	9	× 9	=	81	÷ 5	=	16.2	+ 32	= 48.2.
k	10	× 9	=	90	÷ 5	=	18	+ 32	= 50
l	15	× 9	=	135	÷ 5	=	27	+ 32	= 59
m	14½	× 9	=	130.5	÷ 5	=	26.1	+ 32	= 58.1.
n	Do.								
o	Do.								
p	Do.								
q	3½	× 9	=	31.5	÷ 5	=	6.3	+ 32	= 38.3.
s	8½	× 9	=	74.5	÷ 5	=	14.9	+ 32	= 46.9.
	8	× 9	=	72	÷ 5	=	14.4	+ 32	= 46.4.
t	11	× 9	=	99	÷ 5	=	19.8	+ 32	= 51.8.
u	10.5	× 9	=	94.5	÷ 5	=	18.9	+ 32	= 50.9.
(1)	10	× 9	=	90	÷ 5	=	18	+ 32	= 50
	9	× 9	=	81	÷ 5	=	16.2	+ 32	= 48.2.
(2)	8½	× 9	=	76.5	÷ 5	=	15.3	+ 32	= 47.3.
(3.)	11½	× 9	=	103.5	÷ 5	=	20.7	+ 32	= 52.7.
(4.)	Same as 1.								
(5.)	Do.								
(6)	7	× 9	=	63	÷ 5	=	12.6	+ 32	= 44.6.
(7.)	5	× 9	=	45	÷ 5	=	9	+ 32	= 41
	4.5	× 9	=	40.5	÷ 5	=	8.1	+ 32	= 40.1.
(8)	5.5	× 9	=	49.5	÷ 5	=	9.9	+ 32	= 41.9.
(9.)	Same as *s*, 2d.								
(10)	Same as 1, 2d.								
(11.)	1	× 9	=	9	÷ 5	=	1.8	+ 32	= 33.8.
(13.)	Same as 1, 2d.								
(14)	Same as 6.								
(16)	Do.								
(17.)	12	× 9	=	108	÷ 5	=	21.6	+ 32	= 53.6.
(18.)	Do.								
(19)	Same as *b*.								
(20)	11 = 51.8 & 10 = 50.								
(21.)	11 = 51.8.								
(22)	16	× 9	=	144	÷ 5	=	28.8	+ 32	= 60.8.
(23)	10 = 50.								
(24.)	9 = 48.2.								
(25.)	13½ = 56.3.								
(26.)	Do.								
(27.)	1 = 33.8.								
	8 = 46.4.								
(28.)	13	× 9	=	117	÷ 5	=	23.4	+ 32	= 55.4.
(29)	1 = 33.8.								
(30.)	15 = 59.								
(31.)	8½ = 47.3.								

– .22 = 29.61	59	60.8
– .22 = 29.524	60	62.6
	B. = 1	A. 123.4
24		1.4701752
		9.9999566
		1.4701318
61		1.4714384
		0.0013066
		7.1161427
		9.9998775
		4.8084019
		1.9244221

ending.
Rathbun's.

29.744 — .22 = 29.524	60	62.6
ill, 29.814 — .22 = 29.594	55	57.2
	B. = 5	A. 119.8
		1.4701752
		9.9997828
		1.4699580
		1.4712037
		0.0012457
		7.0954135
		9.9998775
		4.8067690
		1.9020600

lescending.

814 — .22 = 29.594	55	57.2
664 — .22 = 29.444	53	54.5
	B. 2	A. 111.7
		1.4689968
		.0000869
		1.4690837
		1.4712037
		0.0021200
		7.3263359
		9.9998775
		4.8030731
		2.1292865

t ascending.

a 29.664 — .22 = 29.444 53
b 29.350 — .22 = 29.13 54

Log. 29.13 .....
B. 54 — 53 = 1 .....

Log. 29.444 .....

R .....

Log. R .....
Lat .....
A. 54.5 + 56.3 = 110.8 .....

298.27 feet ascending.

b 29.350 — .22 = 29.13. 54
c 29.266 — .22 = 29.046 56

Log. c. 29 046 .....
B. 56 — 54 = 2 .....

Log. b .....

R .....

Log. R .....
Lat .....
A. 56.3 + 58.1 = 114.4 .....

85.437 feet ascending.

a 29.664 — .22 = 29.444 53
f 28.998 — .22 = 28.778 55

Log f 28.778 .....
B 53 — 55 = 2 .....

Log. a 29.444 .....

R .....

Log. R .....
Lat .....
A. 54.5 + 57.2 = 111.7 .....

700.25 feet ascending.
Sum of these calculations (a and f) 701.21 ascending.

c 29.266 — .22 = 29.046 56
d 29.142 — .22 = 28 922 55

Log. d 28.922 .....
B. 56 — 55 = 1 .....

Log. c 29.046 .....

R .....

Log. R .....
Lat .....
A. 58.1 + 57.2 = 115.3 .....

115.71 feet ascending.

29.142 — .22 = 28.922	55	57.2
28.998 — .22 = 28.778	55	57.2
og. f 28.778		1.4580606
= 0. Log. d 28.922		1.4612283
		0.0031677
og. R.		7.5007440
at.		9.9998775
. 57.2 + 57.2 = 114.4.		4.8043089
		2.3049304

201.8 feet ascending.

f 28.998 — .22 = 28.778	55	57.2
g 28.874 — .22 = 28.654	55	57.2
Log. f 28.778		1.4580606
B. = 0. Log. g 28.654		1.4571853
R.		0.0008753
Log. R.		6.9421569
Lat.		9.9998775
A. 57.2 + 57.2 = 114.4.		4.8043089
		1.7463433

55.763 feet ascending.

g 28.874 — .22 = 28.654	55	57.2
y 28.708 — .22 = 28.488	54	56.0
Log. y 28.488		1.4546620
B. 55 — 54 = 1		0.0000434
		1.4547054
Log. g 28.654		1.4571853
R.		0.0024799
Log. R.		7.3944342
Lat.		9.9998775
A. 57.2 + 56 = 113.2.		4.8037602
		2.1980719

157.89 feet ascending.

y 28.708 — .22 = 28.488	54	56
h 28.796 — .22 = 28.576	48	50
Log. y 28.488		1.4546620
B. 54 — 48 = 6		9.9997393
		1.4544013
Log. h 28.576		1.4560014
R.		0.0016001
Log. R.		7.2041471
Lat.		9.9998775
A. 56 + 50 = 106.		4.8004533
		2.0044779

— 101.03 feet descending.

i 28.726 — .22 = 28.506	38	41
j 28.766 — .22 = 28.546	46	48
Log. i 28.506		1.45
B. 46 — 38 = 8		0.00
Log. j 28.546		1.45
R		0.00
Log. R		6.41
Lat		9.99
A. 40.1 + 48.2 = 88.3		4.79
		1.20

— 16.216 feet descending.

j 28.766 — .22 = 28.546	46	48
k 28.684 — .22 = 28.464	48	50
Log. k 28.464		1.45
B. 48 — 46 = 2		9.99
Log. j 28.540		1.45
R		0.00
Log. R		7.12
Lat		9.99
A. 50 + 48.2 = 98.2		4.79
		1.92

+ 83.662 feet ascending.

k 28.684 — .22 = 28.464	48	50
l 28.616 — .22 = 28.396	57	59
Log. l 28.396		1.45
B. 57 — 48 = 9		9.99
Log. k 28.464		1.45
R		0.00
Log. R		7.15
Lat		9.99
A. 59 + 50 = 109		4.80
		1.95

90.564 feet ascending.

l 28.616 — .22 = 28.396	57	59
m 28.628 — .22 = 28.408	56	58.1
Log. l 28.396		1.45
B. 57 ‡‡ — ‡‡ 56 = 1		.00
Log. m 28.408		1.45
R		0.00
Log. R		6.14
Lat		9.99
A. 58.1 + 59 = 117.1		4.80
		0.95

8.95 feet descending.

- .22 = 28.408	56	58.1
- .22 = 28.32	56	58.1
)		1.4520932
og. m 28.408		1.4534407
		0.0013475
		7.1295288
		9.9998775
8.1 = 116.2		4.8051106
		1.9345169

ending.

- .22 = 28.32	56	58.1
- .22 = 28.448	56	58.1
2		1.4520932
g. o 28.448		1.4540517
		0.0019585
		7.2919236
		9.9998775
8.1 = 116.2		4.8051106
		2.0969117

scending.

- .22 = 28.414	38.3	38.3
- .22 = 28.432	53.6	53.6
4		1.4535324
8.3 = 15.3		.0006639
		1.4541963
2		1.4538074
		0.0003889
		6.5898379
		9.9998775
8.3 = 91.9		4.7939636
		1.3836190

descending.

.22 = 28.23	46.9	46.4
.22 = 28.28	51.8	51.8
		1.4507109
5.9 = 4.9		0.0002124
		1.4509233
		1.4514794
		0.0005561
		6.7451529
		9.9998775
5.4 = 98.2		4.7968422
		1.5418726

t descending.

t 28.5 — .22 = 28.28	51.8	
u 28.53 — .22 = 28.31	51.8	
Log. t 28.28		1.451
B. = 0. Log. u 28.31		1.451
R		0.000
Log. R		6.663
Lat		9.999
A. 51.8 + 50.9 = 102.7		4.798
		1.462

28.97 feet descending.

How to connect this observation (u) with the next, (t,) I do not know. u is taken during forenoon of the 18th. The question arises, did you encamp? I find, by Kendall's tables, at Copper Harbor there was a fall of the mercury; but doubt if a base is good for anythin so great a distance. I will calculate u and t, and you must use your discretion in throwin out. Its value is 0, I suppose.

u 28.53 — .22 = 28.31	56.8	
(1) 28.45 — .22 = 28.23	50.0	
Log. (1) 28.23		1.450
B. 51.8 — 50 = 1.8		.000
		1.450
Log. u 28.31		1.451
R		0.001
Log. R		7.059
Lat		9.999
A. 50.9 + 48.2 = 99.1		4.797
		1.856

71.908 feet ascending.

(1.) 28.45 — .22 = 28.23	50.0	
(2.) 28.492 — .22 = 28.272	48.2	
Log. (1) 28.23		1.45
B. 50 — 48.2 = 1.8		.00
		1.45
Log (2) 28.272		1.45
R		0.08
Log. R		6.75
Lat		9.99
A. 48.2 + 47.3 = 95.5		4.79
		1.54

35.428 feet descending.

(2.) 28.492 — .22 = 28.272	48.2	
(3.) 28.5 — .22 = 28.28	51.8	
	B. 3.6	A.

272	1.4513565
	0.0001561
	1.4515126
28	1.4514794
	0.0000332
	5.5211381
	9.9998775
	4.7976784
	0.3186940

escending, (?)

second instance where the correction for thermometer is so great as to more than or the barometrical difference. Now I find nothing which indicates either that you tionary or had moved. However, the difference is so slight in the elevation, that it liscernible in a plan of the route.

REPORTS

ON

THE LINEAR SURVEYS,

WITH

REFERENCE TO MINES AND MINERALS

IN

THE NORTHERN PENINSULA OF MICHIGAN,

In the years 1845 *and* 1846.

TABLE OF CONTENTS.

al report of William A. Burt on survey of township lines in 1845.

	Page.
r	811
iber	811
l harbors	812
iber in trap range of Keewenaw point	812
and harbors	813
	813
nountains	814
	814
ck	815
s slates	816
riegated sandstone	816
, Keewenaw point	817
ue rock	817
reinstone	818
nglomerate rocks of the Porcupine mountains	819
	820
narks	820
r statement of specimens collected on foregoing survey—	
48 north, range 25 west	821
ndary of township 48 north, range 26 west	821
ndary of township 48 north, range 27 west	821
undary of township 49 north, range 25 west	821
ndary of township 49 north, range 26 west	821
undary of township 49 north, range 26 west	821
ndary of township 49 north, range 27 west	821
undary of township 50 north, range 26 west	821
ndary of township 50 north, range 27 west	822
undary of township 51 north, range 27 west	822
ndary of township 51 north, range 28 west	822
undary of township 51 north, range 28 west	822
ndary of township 51 north, range 29 west	822
undary of township 51 north, range 30 west	823
ndary of township 51 north, range 31 west	823
undary of township 51 north, range 31 west	824
ndary of township 51 north, range 32 west	824
undary of township 51 north, range 32 west	824
ndary of township 51 north, range 32 west	824

On south boundary of township 51 north, range 33 west.....
On east boundary of township 51 north, range 34 west.....
On south boundary of township 51 north, range 37 west.....
On east boundary of township 51 north, range 38 west.....
On south boundary of township 51 north, range 38 west.....
On south boundary of township 51 north, range 39 west.....
On east boundary of township 51 north, range 39 west.....
On south boundary of township 51 north, range 40 west.....
On south boundary of township 51 north, range 41 west.....
On east boundary of township 51 north, range 42 west.....
On south boundary of township 51 north, range 42 west.....
On east boundary of township 51 north, range 43 west.....
On south boundary of township 51 north, range 43 west.....
On east boundary of township 51 north, range 44 west.....
On south boundary of township 52 north, range 28 west.....
On east boundary of township 52 north, range 29 west.....
On south boundary of township 52 north, range 29 west.....
On east boundary of township 52 north, range 30 west.....
On south boundary of township 52 north, range 30 west.....
On east boundary of township 52 north, range 34 west.....
On south boundary of township 52 north, range 35 west.....
On east boundary of township 52 north, range 36 west.....
On south boundary of township 52 north, range 37 west.....
On east boundary of township 52 north, range 37 west.....
On south boundary of township 53 north, range 33 west.....
On south boundary of township 53 north, range 36 west.....
On east boundary of township 53 north, range 36 west.....
On south boundary of township 53 north, range 37 west.....
In township 53 north, range 38 west.....
On east boundary of township 54 north, range 32 west.....
On east boundary of township 54 north, range 34 west.....
On south boundary of township 54 north, range 36 west.....
On south boundary of township 55 north, range 34 west.....
On south boundary of township 55 north, range 36 west.....
On east boundary of township 56 north, range 31 west.....
On south boundary of township 56 north, range 31 west.....
On south boundary of township 56 north, range 33 west.....
On east boundary of township 56 north, range 33 west.....
On east boundary of township 57 north, range 30 west.....
On south boundary of township 57 north, range 30 west.....
On east boundary of township 57 north, range 31 west.....
On south boundary of township 57 north, range 32 west.....
On east boundary of township 57 north, range 33 west.....
On south boundary of township 57 north, range 33 west.....
On east boundary of township 58 north, range 28 west.....
On east boundary of township 58 north, range 29 west.....

Page.
undary of township 58 north, range 30 west 828
ndary of township 58 north, range 30 west 828
ndary of township 58 north, range 31 west 827, 832
undary of township 58 north, range 31 west..... 826, 828
undary of township 58 north, range 32 west..... 827
ndary of township 58 north, range 32 west..... 826
59 north, range 28 west..... 832
ndary of township 59 north, range 28 west..... 828
ndary of township 59 north, range 30 west..... 827
ndary of township 59 north, range 29 west..... 832

ıl report of Bela Hubbard on subdivisional surveys by Dr. Houghton, in 1845.

ks..... 833
ie group..... 834
..... 836
ck..... 836
Keewenaw point..... 836
te rock..... 838
lomerate and sand rock..... 838
..... 839
is..... 840
arks..... 840

ıl report of Wm. A. Burt, on surveys of township lines, in 1846.

..... 842
lakes..... 843
ber..... 844
geology..... 844
l sienites..... 845
argillaceous slates..... 846
ınd hornblende slates..... 847
..... 847
stone..... 848
ıandstone..... 848
estone..... 848
ne and red clay..... 849
..... 849
s. 849
ırks..... 852
statement of specimens collected on foregoing survey—
ındary of township 41 north, range 24 west..... 853
ıdary of township 41 north, range 27 west..... 853

On south boundary of township 41 north, range 27 west.....
On east boundary of township 41 north, range 28 west.....
On east boundary of township 41 north, range 29 west.....
On south boundary of township 41 north, range 29 west.....
On east boundary of township 41 north, range 30 west.....
On east boundary of township 41 north, range 32 west.....
On south boundary of township 42 north, range 24 west.....
On east boundary of township 42 north, range 25 west.....
On south boundary of township 42 north, range 25 west.....
On east boundary of township 42 north, range 28 west.....
On south boundary of township 42 north, range 28 west.....
On east boundary of township 42 north, range 29 west.....
On south boundary of township 42 north, range 29 west.....
On east boundary of township 42 north, range 30 west.....
On south boundary of township 42 north, range 30 west.....
On south boundary of township 42 north, range 31 west.....
On east boundary of township 42 north, range 32 west.....
On south boundary of township 42 north, range 32 west.....
On east boundary of township 42 north, range 33 west.....
On south boundary of township 43 north, range 28 west.....
On east boundary of township 43 north, range 29 west.....
On east boundary of township 43 north, range 30 west.....
On south boundary of township 43 north, range 30 west.....
On south boundary of township 43 north, range 31 west.....
On east boundary of township 43 north, range 31 west.....
On east boundary of township 43 north, range 32 west.....
On south boundary of township 43 north, range 32 west.....
On east boundary of township 43 north, range 33 west.....
On south boundary of township 43 north, range 33 west.....
On east boundary of township 43 north, range 34 west.....
On east boundary of township 43 north, range 36 west.....
On east boundary of township 44 north, range 30 west.....
On south boundary of township 44 north, range 31 west.....
On south boundary of township 44 north, range 32 west.....
On east boundary of township 44 north, range 32 west.....
On east boundary of township 44 north, range 33 west.....
On south boundary of township 44 north, range 33 west.....
On east boundary of township 44 north, range 34 west.....
On east boundary of township 44 north, range 35 west.....
On south boundary of township 45 north, range 29 west.....
On south boundary of township 45 north, range 31 west.....
On east boundary of township 45 north, range 32 west.....
On east boundary of township 45 north, range 33 west.....
On south boundary of township 45 north, range 33 west.....
On south boundary of township 45 north, range 35 west.....
On east boundary of township 45 north, range 35 west.....

Page.
y of township 45 north, range 36 west 860
y of township 46 north, range 28 west 860
y of township 46 north, range 29 west 860
ary of township 46 north, range 29 west 860
y of township 46 north, range 30 west 860
ary of township 46 north, range 30 west 861
y of township 46 north, range 31 west 861
ary of township 46 north, range 31 west 861
y of township 46 north, range 33 west 862
ary of township 46 north, range 33 west 862
y of township 46 north, range 35 west 862
ary of township 46 north, range 35 west 862
ary of township 46 north, range 36 west 862
ary of township 47 north, range 27 west 862
y of township 47 north, range 28 west 863
ary of township 47 north, range 28 west 863
ary of township 47 north, range 29 west 863
y of township 47 north, range 29 west 863
y of township 47 north, range 30 west 863
ary of township 47 north, range 30 west 864
y of township 47 north, range 31 west 864
ary of township 47 north, range 31 west 864
y of township 47 north, range 33 west 865
ary of township 47 north, range 33 west 865
y of township 47 north, range 34 west 865
ary of township 47 north, range 34 west 865
y of township 47 north, range 35 west 865
ary of township 48 north, range 27 west 865
y of township 48 north, range 28 west 865
ary of township 48 north, range 28 west 866
y of township 48 north, range 29 west 866
ary of township 48 north, range 29 west 866
y of township 48 north, range 30 west 866
ary of township 48 north, range 30 west 867
y of township 48 north, range 31 west 867
ary of township 48 north, range 31 west 868
y of township 48 north, range 32 west 868
ary of township 48 north, range 32 west 868
y of township 48 north, range 33 west 868
ary of township 48 north, range 33 west 868
y of township 48 north, range 34 west 863
ary of township 48 north, range 34 west 868
y of township 48 north, range 35 west 869
ary of township 49 north, range 27 west 869
y of township 49 north, range 28 west 869
ary of township 49 north, range 28 west 869

On east boundary of township 49 north, range 29 west.....
On east boundary of township 49 north, range 30 west.....
On south boundary of township 49 north, range 29 west.....
On south boundary of township 49 north, range 30 west.....
On east boundary of township 49 north, range 31 west.....
On south boundary of township 49 north, range 31 west.....
On east boundary of township 49 north, range 32 west.....
On south boundary of township 49 north, range 32 west.....
On south boundary of township 49 north, range 33 west.....
On east boundary of township 49 north, range 33 west.....
On east boundary of township 49 north, range 36 west.....
On south boundary of township 50 north, range 27 west.....
On east boundary of township 50 north, range 28 west.....
On south boundary of township 50 north, range 28 west.....
On east boundary of township 50 north, range 29 west.....
On south boundary of township 50 north, range 29 west.....
On east boundary of township 50 north, range 30 west.....
On south boundary of township 50 north, range 30 west.....
On east boundary of township 50 north, range 31 west.....
On south boundary of township 50 north, range 31 west.....
On east boundary of township 50 north, range 32 west.....
On south boundary of township 50 north, range 32 west.....
On east boundary of township 50 north, range 33 west.....
On south boundary of township 50 north, range 33 west.....
On east boundary of township 50 north, range 34 west.....

Botanical report and catalogue of plants, by William A. Burt, in 184

Exogenous.....
Endogenous.....
Acrogenous.....

Geological report of Bela Hubbard on subdivisional surveys of S. Higgins, in 1846.

Topography east of the Ontonagon.....
Soil and timber of the Ontonagon.....
Soil and timber of trap region.....
Topography of Porcupine mountains.....
Tertiary clays.....
Rocks.....
Trap rocks.....
Red, slaty, argillaceous, and silicious.....
Conglomerate.....
Black argillaceous slate.....
Red and gray sand rock.....
Mineral veins.....

Page.
eous veins..... 892
..... 893

statement of specimens collected on foregoing survey—
51 north, range 44 west..... 894
51 north, range 43 west..... 894
51 north, range 42 west..... 894
51 north, range 38 west..... 895
52 north, range 38 west..... 895
53 north, range 38 west..... 895
51 north, range 37 west..... 895
53 north, range 37 west..... 896
52 north, range 36 west..... 896
54 north, range 36 west..... 897
55 north, range 36 west..... 897
52 north, range 35 west..... 897
53 north, range 35 west..... 897
54 north, range 35 west..... 898
55 north, range 35 west..... 898
53 north, range 34 west..... 898
54 north, range 34 west..... 898

l report of Bela Hubbard on subdivisional surveys by William Ives, in 1846.

..... 899
try..... 899
intry..... 900
untry..... 901
reams..... 901
sienites..... 901
..... 903
: rocks..... 904
..... 905
..... 906
s..... 907
f trap rocks..... 909
ridge..... 910

statement of specimens collected on foregoing survey—
49 north, range 25 west..... 912
49 north, range 26 west..... 914
50 north, range 25 west..... 917
50 north, range 26 west..... 918
51 north, range 26 west..... 919
51 north, range 27 west..... 920
51 north, range 28 west..... 922
51 north, range 29 west..... 925

In township 51 north, range 30 west.....
In township 51 north, range 31 west.....
In township 52 north, range 27 west.....
In township 52 north, range 28 west.....
In township 52 north, range 29 west.....
In township 52 north, range 30 west.....
In township 52 north, range 31 west.....
In township 53 north, range 29 west.....
In township 53 north, range 30 west.....
In township 53 north, range 31 west.....

Catalogue of specimens collected by William A. Burt during sur township lines, in 1844.

In township 40 north, range 23 west.....
On south boundary of township 41 north, range 23 west.....
On east boundary of township 41 north, range 24 west.....
In township 42 north, range 24 west.....
On south boundary of township 43 north, range 26 west.....
On east boundary of township 43 north, range 26 west.....
In township 43 north, range 25 west.....
On south boundary of township 46 north, range 25 west.....
On east boundary of township 45 north, range 26 west.....
On east boundary of township 47 north, range 26 west.....
On east boundary of township 47 north, range 25 west.....
On south boundary of township 48 north, range 25 west.....
On east boundary of township 47 north, range 26 west.....
On south boundary of township 48 north, range 26 west.....
On east boundary of township 47 north, range 27 west.....
On south boundary of township 47 north, range 26 west.....
In township 44 north, range 25 west.....
In township 39 north, range 23 west.....
In township 40 north, range 22 west.....
On south boundary of township 41 north, range 23 west.....
On south boundary of township 40 north, range 23 west.....

OLOGICAL REPORT OF SURVEY OF TOWNSHIP LINES, &c., BY WM. A. BURT, D. S, IN 1845.

pography and geology of the survey, with reference to mines and minerals, of a district of township lines south of Lake Superior.

This survey embraces Keweenaw point and a narrow tract of land rdering the south coast of Lake Superior, from the south boundary of wnship 48 north, ranges 25 and 26 west, near Chocolate river, to the outh of Carp river, on the northwest side of the Porcupine mountains, township 51 north, range 44 west.

See the accompanying map, to which reference will be frequently made the course of these remarks. Upon this map are delineated the bounds of the survey, together with the principal streams and small lakes. ie straight lines are the boundaries of townships, with their numbers d ranges, and the irregular lines of different colors represent the bounds of the different rock formations, with their characteristic names on side which they occupy.

The topography of this district may be divided into two parts—the ly or mountainous, and the undulating or rolling lands.

Of the hilly or mountainous land, three tracts of considerable areas are nd, widely separated by undulating or rolling land.

That part of the district situated between Huron bay and the south ndary of townships 48 north, ranges 25 and 26 west, and denomted primary range on the map, is made up principally of numerous ky knobs and irregular hills, with intervening valleys of arable lands. st of these valleys have small streams, meandering through them with id or quick currents of pure water. Between some of these knobs and ls, however, cedar, tamerack, or spruce swamps are found, and less quently small lakes.

The highest elevations on this range probably attain an altitude of 800 900 feet above the water of Lake Superior, and present to the spectator ery rugged and broken appearance, and frequently along the southsterly slope of these knobs and hills, which are generally the most preitous, high cliffs or sloping ledges are seen; but along the south boundy of the survey the hills are more regular in outline, and have a westy direction.

The land upon this part of the district not occupied by the primary ge is undulating or rolling, except where furrowed with deep ravines, interrupted by the valleys of streams.

These lands lie between the primary range and the lake coast, and are many places considerably elevated, forming bluffs on the lake coast m twenty to eighty feet in height.

Soil and timber.

The soil upon this part of the survey is generally a sandy loam, but in ne places it is decidedly a sandy soil, and sustains a heavy growth of ber, of sugar, hemlock, birch, pine, cedar, fir, lynn, elm, ash, spruce, erack, &c.

Streams and harbors.

The largest streams (rivers they are called here) on this part of tl trict are not above the size of ordinary mill streams, for which p they would answer well, having generally falls or rapids within two miles from the lake coast. Some of these streams, at their m form convenient harbors for small boats, and may be ascended wit to the first falls or rapids, for which purpose the Huron, Spruce Yellow Dog, and Nekomenon or Dead rivers are the best.

The only harbors for vessels are at Presq'isle, township 48 north, 25 west, and to the south of a point of land on the east side of bay, township 52 north, range 31 west.—(See map.)

Trap range of Keweenaw point, &c.

This second hilly range commences at the northeast end of Kew point, and has a course a little to the south of west for about ei miles, where it gradually bends to the southward, until its general is southwest, to the south boundary of the survey.

This range is from two to six or seven miles wide, and about miles in length upon this district, and from the east end of Kew point to a little west of the east boundary of range 29, these hills py nearly its entire breadth. Here the southeast side of this range r from the lake coast, and, stretching inland southwesterly, passes alo northwest side of a small lake in townships 55 north, ranges 32 a west; from thence generally in a southwest direction to the corner tions 31 and 32 on south boundary of township 51 north, range 37

The northwest boundary of this range leaves the lake coast in ship 58 north, range 32 west, and, stretching a little inland, c Portage lake in township 55 north, range 34 west; thence general southwest direction, to near the corner of sections 33 and 34 on the boundary of township 51 north, range 38 west. The highest elev upon this hilly range are supposed to be from five to eight hundr above Lake Superior; and, as in the hills of the primary range a described, their southeasterly sides are generally the most precipitou it should be further remarked that these hills are not destitute of i in an agricultural point of view. Considerable tracts of tillable la found upon them, with a good soil, and well timbered with sugar, lynn, ironwood, red oak, &c., and on Keweenaw point better ada cultivation than most of the land upon its coast.

To the east of this hilly range (south of Portage lake) to Huro and west of it to the Porcupine mountains, with the exception of moderately elevated hills, the country is undulating or rolling; the however, many deep ravines and valleys of streams to be found part, also tracts of level land. These lands are generally susc of cultivation; and so far as they have been proved at the mission the head of Keweenaw bay, and at the Ontonagon and Iron river been found to yield abundantly in produce suitable for cultivation climate.

The climate, modified by this inland sea, has been found to b mild than heretofore supposed, and no doubt now exists but the a turist may be rewarded on these lands for his labor.

Over this entire tract, except where occupied by swamps, or in some ces on the lake coast west of Keweenaw point, the soil is generally a dy loam, and the most loamy parts are in the valleys of the Sturgeon d Ontonagon rivers.

These lands are extensive, and generally support a heavy growth of ber, of sugar, birch, hemlock, pine, fir, cedar, lynn, ash, elm, and ce, &c.

And it may be worthy of remark, that scattering pines of an excellent lity may be found southeast of the hilly range of Keweenaw point, d northeast of Portage lake, to the south boundary of township 57 N., ge 30 W.

Lake coast and harbors.

The lake coast is generally bold and rocky, and though very irregular its course, has few indications of a character to form good harbors for sels. The best and most convenient are Copper, Agate, and Eagle bors, situated on the north side of Keweenaw point.—(See map.) o, a lee can generally be made south of a point on the east side of weenaw bay, in township 51 N., range 32 W.; and a vessel drawing feet of water may enter the Ontonagon river, in township 52 N., range W.

Rivers.

Upon this part of the district there are three rivers navigable for small fts for a considerable distance into the country: they are the Portage, rgeon, and Ontonagon rivers.

Sturgeon river has its source to the south of the head of Keweenaw r, in the hilly country, and runs northerly nearly parallel to the west st of this bay, and enters Portage lake on section 33, township 54 N., ge 33 W., and may be ascended with small boats into township 52 N., ge 33 W., section 7; here its navigation is interrupted by drift wood, ich fills the channel for about 25 or 30 chains. This passed, which y be done by a good portage, the river may be ascended into township N., range 34 W.; but on account of a strong current in this stream, ing-poles or the best of oarsmen are necessary to effect an ascent to s point.

Portage river is about four miles in length, and the outlet of Portage e. It is a stream of considerable depth and breadth, and, after passing bar at its mouth, may be ascended with vessels drawing eight feet of ter, into Portage lake, and thence to the head of this lake, near the th boundary of township 56 north, range 34 west, about twenty miles m the entrance at the mouth of Portage river.

From the head of Portage lake light-boats ascend a small stream about e mile, and from thence, by a portage of another mile over nearly level d, enter Lake Superior.

Doubtless at some future day these two miles will be canaled, for the sage of larger crafts through this channel into Lake Superior.

The Ontonagon river is the largest stream on the south side of Lake perior. This stream is navigable for batteaux, in an ordinary stage of

water, to the rapids near the south boundary of township 51 north, r
39 west.

Near the mouth of this river, on the right bank, is an eligible site
town, and when this harbor is improved, as it deserves to be, will p
bly become a place of considerable importance.

There are other small streams on this part of the survey, the most
portant of which are Eagle, Elm, Misery, Sleeping, Fire-steel, and
rivers.

These streams cannot be ascended far, even with canoes, on accou
rapids or drift wood; but most of them form convenient harbors for
boats on the lake coast.

Porcupine mountains.

The third hilly range embraces the northerly portion of the Porcup
mountains, the easterly boundary of which commences on the coas
Lake Superior, three or four miles west of the mouth of Iron river
township 51 north, range 42 west, thence nearly south to corner of
tions 33 and 34, on south boundary of said township. Westward th
knobby mountains spread over the remaining part of the survey to
coast of Lake Superior; the highest elevations of which have an altit
probably of 950 feet, and the easterly hills have a more regular out
than those of the westerly part, the latter, in some places, presen
cliffs and sloping ledges of great height.

These mountains, and the valleys between them, except near the
coast, or where occupied by rocks, have a good soil of sandy loam, wi
supports a heavy growth of timber, of sugar, birch, lynn, hemlock,
elm, &c.

The lake coast bordering these mountains is generally rocky,
affords no good harbors for small boats, except at Carp river. This str
runs WSW., nearly parallel to the coast of the lake, for about ten m
and at the distance of about two miles from the coast. It then bend
the northwest, and after passing falls and rapids near its mouth, en
Lake Superior on section 33, township 51 north, range 44 west.

Geology.

Within the boundaries of this survey there are five principal grou
rocks, which occupy large areas. They are primary, trap, conglomer
sandstone, and slates.

That group of rocks which may be denominated primary, and inclu
the metamorphic rocks on the south, are found generally a little in
(except in the vicinity of Presq'isle harbor) from the coast of Lake S
rior; and from the south boundary of townships 48 north, ranges 25 an
west, into township 51 north, and range 32 west, about 3 miles S
of the head of Huron bay.—(See map.)

These rocks make up a series of knobs and high conical hills, form
a broken range, which has a course, as near as could be determined,
southwest. These elevations are of various heights, probably from 7
900 feet above Lake Superior; and generally the elevating force app
to have acted mostly upon their southeasterly side, as this side gene

ents cliffs and bold ledges, while their northwesterly sides slope away
e gradually.
he metamorphic rocks alluded to flank the primary rocks on the south,
re the two become so much interstratified and blended with each
r as to make it difficult to define a line of junction between them. It
, however, be approximately drawn, commencing at the lower falls of
Nekomenon or Dead river, about one mile SSW. of Presq'isle harbor,
ce running WNW. to corners of sections 31 and 32, on south bound-
f township 49 N., range 25 W., and curving a little westerly, crossing
ast boundary of township 49 N., range 27 W., near the corner of sec-
25 and 36.
he principal rocks which compose the metamorphic group are quartz,
pact and granular; imperfect talcose slates, which are in some in-
es slightly argillaceous, and slaty hornblende. These rocks are
or less stratified and imperfectly jointed, and their cleavages dip
ally NNE. In two instances, however, they were seen to dip SSW.
veins of quartz were seen traversing these rocks, but no one was
ved to be metalliferous. I have, however, seen specimens of specu-
n ore, said to have been obtained in township 48 N., range 26 W.
hin the boundaries of the metamorphic rocks upon this survey, sev-
nobs of sienitic granite, and also dikes of greenstone, were seen.

Primary rocks.

at portion of this range which may be denominated primary rock,
ying to the north of the metamorphic rocks already described, is gen-
composed of granular quartz, felspar, and hornblende, constituting
pact sienite; in some places slight traces of mica are observable,
g rise to a sienitic granite.
ese minerals predominate in different proportions in different places,
ot unfrequently in different parts of the same ledge or hill.
some places it is mostly a hornblende rock; and in others the
g minerals are felspar and hornblende, giving rise to a sienitic
stone, and less frequently a well formed granite is found. In sev-
instances a compact greenstone was found intruded among these
s in various forms; and when in veins or dikes, these do not appear
ve any particular magnetic bearing. One of these veins may be
d of about one foot thickness, traversing a ledge of sienite west-south-
at 45.60 chains, in going west on south side of section 36, south
dary of township 51 north, range 28 west.
roughout this entire group of rocks, quartz and felspar veins are
found, and in many instances both are seen traversing the same
and crossing each other at various angles. These veins are from
to a foot or more in width, and were observed to be more frequent
of a larger size in townships 51 and 52 north, ranges 28 and 29 west,
in any other part of the primary range; also a few veins containing
reous spar were seen near the junction of the primary and sedi-
ary rocks.
regard to the metalliferous character of any of the veins traversing
rimary rocks on this portion of the mineral region, (so called,) it
be sufficient to say, that no vein indicating a workable quantity of

st of this ledge, on section 2, a good quality of reddish clay was seen, l at several other points on the bay coast in this vicinity.

Trap range of Keweenaw point.

This range commences at the northeast end of Keweenaw point, and s a course generally to the southwest, in a series of trap knobs and ir- ular hills from three to seven or eight hundred feet in height above ke Superior.

Their general topographical character and boundary have been already scribed.—(See map.)

Generally the middle and southeasterly side of this range is a compact enstone, which gradually obtains an amygdaloidal structure; near the rthwest slope of these hills, and along this slope in many places, a de- ed amygdaloid is found, the cavities of which are frequently filled th quartz, calcareous matter, and epidote.

These characters of the trap rock are well sustained throughout this ge on the survey. It has also been observed that generally the slope the trap rock has a much higher angle on the southeast than on the thwest side of this range.

Conglomerate rock.

This rock is of great thickness, and flanks the trap range on the north- st side from the east end of Keweenaw point westward into township N., range 33 W.

The conglomerate rock is made up of sand, pebbles, and small bould- , principally derived from rocks of the trap family, and so firmly ce- nted together that, when broken, these rounded masses frequently ide through the middle. This rock does not appear to be very uni- m in its dip; it may be estimated, however, to dip NNW. from 20° 50°.

Resting conformably upon the conglomerate rock are a series of alter- ing strata of sandstone and conglomerate, embracing between their ata several trap dikes of considerable extent, which dip with these ks to the NNW. at an angle of 30° or 40°. The injection of these es has produced great changes in the rocks by which they are em- ced; the sandstone near the dike is converted into an amygdaloid, l the character of the conglomerate much changed by igneous action. is is exemplified on the point of rocks west of the entrance of Eagle rbor, where they are severally seen. These trap dikes may be seen several other places from Copper Harbor to a little west of the east ndary of township 57 N., range 33 W.

The conglomerate rocks above described were not seen flanking the rthwest side of the trap range of Keweenaw point, (southwest of town- ip 57 N., range 33 W.,) or between this and the lake coast, until they re found on the northwest side of the Porcupine mountains. They supposed to be wanting between these points, or they have diverged m the trap range and occupy the bed of Lake Superior; which latter dition is deemed the most probable, as this direction best conforms to strike of these rocks at both places.

Veins and veinstone.

Between the northeast end of Keweenaw point and Portage lake the trap and conglomerate rocks are traversed by many well-defined veins at nearly right-angles with the general course of the trap range, and at the surface of the rocks these veins are from a mere line to several feet in width.

The veins above alluded to are generally nearly vertical in the rocks they traverse, and in some instances they appear to have been fissures in the rock, and subsequently filled with veinstone, differing much in their character in different rocks. In the greenstone and amygdaloid, these veins are usually made up of trap, more or less associated with quartz, and on their sides finely blended with, and consolidated to, the rocks which they traverse; but in the conglomerate rocks the veins are almost uniformly of calcareous matter. Besides the well-defined veins above alluded to, there are others imperfectly formed, having a more diffusive character. Also, at several places on the lake coast, along the line of conglomerate rocks, veins of calcareous matter were seen, apparently embraced between its strata. These veins have a course nearly at right-angles to the veins before alluded to, and are supposed to be of no very great extent.

Some of these veins, at least, are metalliferous through some portion of their course in the rocks which they traverse, and contain native copper, or some of the ores of copper. Green and blue carbonate and the black oxide are thought to be the most abundant of the ores; and so far as I have been able to observe these veins, their metalliferous character was best developed along the line of junction of the trap and sedimentary rocks on both sides of this trap range.

The metalliferous character of the veins above described have been most explored on the northwest side of Keweenaw point, where some of them are now being worked, and much interest is felt by the enterprising proprietors of these works. Thus far several of these veins offer increased inducements to prosecute the work, and a few years of labor will develop, in some good degree, their true character.

That portion of the trap range of Keweenaw point extending southwest of Portage lake to the south boundary of the survey, has generally less breadth than that which has already been described, and the trap rocks do not so frequently crop out; consequently its junction with the sedimentary rocks could not often be seen. But the aberrations of the magnetic needle (determined by the solar compass) have always been found to be very great on and near the trap hills, by which means it is believed that its boundary on the township lines, where no outcrop could be seen, has been very nearly defined.—(See map.)

But few veins were seen traversing the rocks on this part of the trap range, and no one observed to be metalliferous; creditable reports, however, say that copper veins have been found near the head-waters of Elm river.

Argillaceous slates.

Argillaceous slates of a dark brown color and slaty sandstone are developed on a large scale in the bed and banks of Iron river, through

township 51 N., range 42 W., three or four miles east of the Porcupine mountains. These slates are very variable in the direction and amount of their dip in different places; they vary from NE. to SE., and dip from 15° to 45° in that direction.

These slates were also seen fifty or sixty chains east of Iron river, near the corner of sections 25 and 36, and dipping ENE. about 11°. From these facts it is reasonable to infer that the slates dip under the sandstone to the east of them, and that they extend west to the base of the Porcupine mountains; but these slates, except in the streams before mentioned, are generally overlaid with a considerable depth of earth, and therefore their boundary could not be correctly defined.

Argillaceous slaty sandstones, somewhat similar to those already described, were found on the northwest side of the trap range of Keweenaw point, on the east and south boundaries of township 53 N., range 36 W., (sections 25 and 33.) These slaty sandstones seldom crop out, consequently their limit was not ascertained. These rocks dip considerably to the northwest.

Red sandstone.

Between the slates of Iron river and the trap range of Keweenaw point, (except as above mentioned,) and south of the north half of township 57 north, range 33 west, and the lake coast to the south boundary of the survey, so far as known, the country is underlaid with red sandstone. This rock frequently appears along the lake coast, and in the bed and banks of streams and ravines. The sandstone here is supposed to belong to the same formation of the red sandstone already described. East of the trap range of Keweenaw point its general character is the same, except that in some places it contains more mica. This sandstone was observed to dip most near the trap range in a NNW. direction, which dip diminishes to the coast of Lake Superior. A nicely-jointed and stratified form of this rock may be seen on the lake coast at the south boundary of township 55 north, range 36 west.

Trap and conglomerate rocks of the Porcupine mountains.

The remaining part of the survey embraces the northerly portion of the Porcupine mountains, the boundaries of which have already been described.—(See map.)

These mountains are made up of a somewhat broken range of trap and conglomerate hills, having an estimated height from three hundred to nine hundred and fifty feet above Lake Superior.

South of Carp river (which runs nearly parallel to the lake coast) and the south boundary of the survey, also the west half of township 51 north, range 42 west, embraces the trap rock within this part of the survey, which occupies an area of less than one township.

A large proportion of this trap is very compact; but in some places it is an amygdaloid, the cells of which are generally filled with calcareous matter, or epidote. This trap also varies in color from a dark green or gray to nearly a brick-red.

To the northwest of the trap-rock hills, and separated from them by the valley of Carp river, are two conglomerate hills, having a course

Tabular statement of specimens collected in the survey of township lines, during the year 1845, *by Wm. A. Burt, deputy surveyor.*

No. of specimen.	On section	Distance.		
		Chs.	*lks.*	*Township* 48 *north, range* 25 *west.*
1	.....	.....		Sienite, lower fall of Dead river.
				North, on east boundary of township 48 *north, range* 26 *west.*
2	36	65	83	Var. 4 deg. 15 min. east. Talcose slate, left bank of a stream 29 links wide.
3	25	19	20	Var. 4 deg. 52 min. east.
4	25	42	00	Var. 4 deg. 52 min. north. Talcose slate, left bank of stream on ridge.
		44	50	Same rock.
5	25	80	00	Var. 5 deg. 15 min. east.
6	12	51	60	Var 5 deg. 17 min. east. Sienite, (dark,) left bank of stream 12 links wide, course east-southeast.
7	1	19	00	Var. 4 deg. 50 min. east.
8	1	67	50	Sienite, associated with much quartz.
				East, on south boundary of township 49 *north, range* 25 *west.*
9	31	80	00	Var. 5 deg. 15 min. east.
10	32	65	00	Sienite in knob, 1 chain north of line.
	32	59	00	Var. 7 deg. east, at 30 chains var. 7 deg. 25 min. east, at 40 chains var. 4 deg. 50 min. east.
11	33	40	75	Sienite, with veins of serpentine.
				North, on east boundary of township 49 *north, range* 26 *west.*
12	36	64	50	Sienite, top of conical hill, very high.
13	36	80	00	Sienitic greenstone, north of sec. cor.; var. 3 deg. 5 min. east.
				East, on south boundary of township 50 *north, range* 26 *west.*
14	32	65	00	Hornblende rock, 10 or 12 chains down stream, at foot of falls; also, many veins of quartz.
15	32	65	00	Sienite, on top of the same falls.
				North, on east boundary of township 48 *north, range* 27 *west.*
16	36	53	00	Var. 5 deg. 10 min. east. Brown quartz and sienitic granite.
17	25	12	50	Var. 4 deg. 35 min. east. Talcose slate, with milky quartz.
18	24	4	25	Var. 3 deg. 35 min. east. Talcose slate, with masses of quartz.
19	1	26	50	Var. 6 deg. 10 min. east.
20	1	26	50	
21	1	52	00	Slaty hornblende.
	1	59	00	Var. 3 deg. east.
22	1	20	80	Slaty serpentine, or chloritic slate, from ledge.
				West, on south boundary of township 49 *north, range* 26 *west.*
23	31	39	60	Var. 6 deg. 5 min. east. Trap, with veins of quartz.
				North, on east boundary of township 49 *north, range* 27 *west.*
24	36	2	00	Greenstone trap.
25	36	9	00	Var. 5 deg. 30 min. east. Greenstone trap.
26	36	19	00	Greenstone trap.
27	36	26	00	Hornblende rock.
28	25	32	00	Var. 5 deg. 30 min. east. Sienite; also, greenstone trap.

Tabular statement—Continued.

No. of specimen.	On section	Distance.		
		Chs.	*lks.*	*North, on east boundary of township 52 north, range 29 west.*
52	25	60	00	Var. 5 deg. 18 min. east; granite with veins of serpentine in high hill.
53	25	80	00	Var. 5 deg 18 min. east; granite with veins of serpentine north side of hill.
54	24	46	75	Red sandstone ledge; dip 25 deg. north-northeast.
	13	40	00	Var. 5 deg. east.
				West, on south boundary of township 52 north, range 29 west.
55	35	61	30	Sienitic granite with many veins of quartz in ledge 50 feet in height.
56	34	36	00	Var. 5 deg. 20 min. east; sienitic granite with many veins of quartz and felspar.
	33	00	00	Var. 4 deg. 50 min. east.
a57	33	21	00	Greenstone trap and coarse-grained sienitic granite, on top of hill; many veins of quartz.
	31	00	00	Var. 5 deg 40 min. east.
58	31	80	00	Var. 5 deg. 50 min. east; granite.
59	36	48	00	Sienitic granite.
				North, on east boundary of township 52 north, range 30 west.
60	25	80	00	Var. 5 deg. 5 min. east; sienitic granite.
61	24	80	00	Var. 5 deg. 20 min. east; granite near junction, with sandstone.
				West, on south boundary of township 52 north, range 30 west.
62	36	67	50	Var. 5 deg. 50 min. east; argillaceous slates and imperfect agate loose in bed of stream, (abundant.)
63	36	78	00	
				North, on east boundary of township 51 north, range 32 west.
	36	00	00	Var. 6 deg. 12 min. east; at 61 chains, ledge of greenstone trap.
64	13	40	50	Altered sandstone in bed of stream.
65	13	40	50	*North-northeast 8 chains down stream much disturbed.
66	13	40	50	N. B —A boat may pass to this place.
67	13	00	00	*From Huron bay, * var. 6 deg. east.
68	13	70	00	Var. 6 deg east; greenstone trap, southeast side of knob.
				West, on south boundary of township 51 north, range 30 west.
69	33	17	00	Var. 5 deg. 40 min. east; sienitic greenstone, at fall 5 feet below the line.
70	34	00	75	Var. 5 deg. 23 min. east; sienitic greenstone, in knob 1 chain south of line.
				North, on east boundary of township 51 north, range 31 west.
71	24	13	50	Var. 5 deg 35 min. east; greenstone trap in ledge.
a72	24	00	50	Argillaceous slate, (black,) in south bank of stream.
a73	13	64	50	Var. 5 deg. 20 min. east; argillaceous slate, (gray,) in north side of hill.

Tabular statement—Continued.

No. of specimen.	On section	Distance.		
		Chs.	lks.	*West, on south boundary of township 56 north, range 32 west.*
88	36	80	00	Var. 4 deg. 20 min. east; sandstone; at corner of sections 33 and 34, var. 5 deg. 25 min. east.
				East, on south boundary of township 56 north, range 31 west.
89	34	27	00	Var. 4 deg. 45 min. east; coarse sandstone on lake coast.
90	34	27	00	Micaceous sandstone.
				South, on east boundary of township 54 north, range 32 west.
91	12	2	68	Var. 5 deg. east; red sandstone on lake coast.
				West, on south boundary of township 56 north, range 33 west.
92	36	20	00	Red sandstone; at 40 chs., var. 4 deg. 50 min. east.
93	36	30	00	Var. 4 deg. 55 min. east; sandstone, some altered.
94	36	40	00	Var. 4 deg. 50 min.; sandstone, changed by igneous action.
95	36	60	00	Trappose rock.
96	36	80	00	Var. 5 deg. 20 min. east; greenstone trap in ledge northwest of cor.
97	35	69	00	Trap.
No rock crop out.	35	55	50	Var. 2 deg. 35 min. east; at 60 chs. 50 lks., var. 3 deg. 35 min. east; at 63 chs. 25 lks, var. 55 min. west; at 68 chs. 50 lks., var. 3 deg. 35 min. east.
	35	75	00	Var. 7 deg. 30 min. west; at 79 chs.; var. 11 deg. 30 min. east.
	34	2	50	Var. 5 deg. 50 min. east; at 12 chs. 33 lks., var. 1 deg. 20 min. east; at 19 chs., var. 25 min. west; at 28 chs. 25 lks., var. 3 deg. 40 min. east.
	34	51	00	Var. 1 deg. 30 min. east; at 53 chs. 75 lks., var. 5 deg. 55 east; at 72 chs., var. 2 deg. 10 min. east.
	33	6	00	Var. 50 min. east; at 12 chs., var. 5 deg. east; at 19 chs. 50 lks., var. 30 min. west; at 33 chs. 75 lks., var. 9 deg. 40 min. east.
	33	40	00	Var. 6 deg. 15 min. east; at 58 chs., var. 3 deg. 40 min. east; at 68 chs., var. 8 deg. east; at 76 chs., var. 7 deg. 30 min. east.
	32	20	50	Var. 10 deg. 30 min. east; at 77 chs. 50 lks., var. 7 deg. 20 min. east.
98	34	44	00	Trap?
				North, on east boundary of township 56 north, range 33 west.
99	36	38	00	5 chains up stream, at the falls, veinstone of quartz, containing native copper; also, trap and zeolite.
99	36	38	00	Altered rock below the trap, with veins of green carbonate of copper, &c.
	24	2	50	Var. 6 deg. 20 min. east; at 17 chs., var. 45 min. east; at 38 chs. 60 lks., var. 40 deg. 20 min. east; at 53 chs. 35 lks., var. 1 deg. east.
	13	0	00	Var. 5 deg. 50 min. east; at 80 chs., var. 1 deg. 30 min. east.
	12	12	00	Var. 5 deg. east; at 36 chs., var. east; at 58 chs. 30 lks., var. 1 deg. west.
	12	62	00	Var. 4 deg. 30 min. east; at 66 chs., var. 10 deg. east; at 80 chs., var. 7 deg. 20 min. east.
	1	20	00	Var. 3 deg. 30 min. east; at 64 chs., var. 11 deg. east; at 80 chs., var. 3 deg. 5 min. east.
100	1	40	00	Trap?

Tabular statement—Continued.

No. of specimen.	On section	Distance. Chs.	Distance. lks.	
				North, on east boundary of township 57 *north, range* 3
102	25	73	50	Altered sandstone in bed of stream.
	25	80	00	Var. 7 deg. 45 min. east.
	13	00	00	Var. 4 deg. 30 min. east; at 16 chs., var. 8 deg. east; at 40 chs., var. 8 deg. east; at 80 chs., var. 45 min. east.
				West, on south boundary of township 57 *north, range* 3
103	36	22	75	Amygdaloid trap on ridge north of line.
	36	40	00	Var. 8 deg. 20 min. east; at 80 chs., var. 8 deg. 45 m
				North, on east boundary of township 58 *north, range* 3
104	36	58	00	Greenstone trap foot of ledge.
	36	00	00	Var. 8 deg. 15 min. east.
105	36	71	00	Greenstone trap top of hill.
a105	36	80	00	Var. 6 deg. 40 min. east; native copper from Eag mines, east of cor. to sections 24 and 25.
	25	40	00	Var. 6 deg. 10 min. east; at 80 chs., var. 8 deg. 10 m
				West, on south boundary of township 57 *north, range* 3
106	33	40	00	Var. 2 deg. 10 min. east; amygdaloid trap; cel with quartz and epidote.
	33	80	00	Var. 5 deg. 10 min. east.
a110	32	40	00	Var. 6 deg. 30 min. east; at 55 chs., greenstone ledge.
110	33	40	00	Amygdaloid trap.
	31	00	00	Var. 3 deg. 40 min. east; at 40 chs., var. 1 deg. west; at 80 chs., var. 3 deg. 5 min. east.
				West, on south boundary of township 58 *north, range* 3
107	31	8	55	Greenstone trap in bed of stream.
				West, on south boundary of township 57 *north, range* 3
111	33	46	00	Trap rock.
	33	00	00	Var. 3 deg. 35 min. east; at 40 chs., var. 6 deg. 30 m
				North, on east boundary of township 56 *north, range* 3
108	36	66	00	Red sandstone at 80 chs.; var. 4 deg. 15 min. east.
109	24	76	50	Red sandstone in small stream.
	24	80	00	Var. 5 deg. 10 min. east.
	12	00	00	Var. 5 deg. 20 min. east; at 80 chs., var. 5 deg. 25 m
				North, on east boundary of township 57 *north, range* 3
103	13	79	75	Var. 5 deg. 50 min. east; altered sandstone, with ous spar veins.
	12	40	00	Var. 5 deg. 5 min. east; at 66 chs, var. 7 deg. 10 mi at 75 chs., var. 5 deg. 25 min. east.
112	12	72	00	Greenstone trap, north side of ridge.
113	13	79	50	Altered sandrock and calcareous spar.
	1	00	00	Var. 4 deg. 50 min. east; at 61 chains, var. 6 deg. east, on ridge.

Tabular statement—Continued.

No. of specimen.	On section	Distance. Chs.	Distance. lks.	
				South, on east boundary of township 56 north, range 31 west.
114	25	00	00	Var. 5 deg. 40 min. east; at 60 chains 97 links, sandstone on lake shore, (red and gray.)
				East, on south boundary of township 57 north, range 30 west.
115	35	00	00	Var. 5 deg. 30 deg. east; at 61 chains 3 links, red sandstone on lake shore.
				West, on south boundary of township 58 north, range 32 west.
	36	40	00	Var. 4 deg. 40 min. east; at 49 chains, var. 11 deg. 30 min. east; at 52 chains, var. 2 deg 55 min. east; at 80 chains, var. 4 deg 45 min. east.
116	36	65	00	Native copper in veinstone of trap and quartz from diggings at this place.
	35	00	00	Var. 4 deg. 45 min. east; at 20 chains, var. 10 deg. east; at 25 chains, var. 7 deg. west; at 30 chains 50 links, var. 7 deg. 15 min. east.
	34	00	00	Var. 5 deg. 30 min. east; at 5 chains 75 links, var. 10 deg. 30 min. east; at 28 chains, var. 14 deg. 30 min. east; at 72 chains, var. 8 deg. 20 min. east.
	32	00	00	Var. 7 deg. 30 min. east; at 40 chains, var. 7 deg. 15 min. east; at 80 chains, var. 7 deg. 45 min. east.
				North, on east boundary of township 58 north, range 31 west.
117	24	60	00	Amygdaloidal trap cells, filled with calcareous matter and quartz.
	36	00	00	Var. 4 deg. 30 min. east; at 20 chains 50 links, var. 7 deg. 20 min. east; at 36 chains, var. 2 deg. 50 min. east; at 40 chains, var. 10 deg. 50 min. east.
	25	00	00	Var. 6 deg. 50 min. east; at 40 chains, var. 3 deg. 50 min. east; at 80 chains, var. 3 deg. 50 min. east.
	13	00	00	Var. 6 deg 50 min. east; at 40 chains, var. 6 deg. 15 min. east; at 80 chains, var. 4 deg east.
	1	00	00	Var. 6 deg. 50 min. east; at 40 chains, var. 6 deg. 30 min. east; at 70 chains 75 links, var. 7 deg. 30 min. east, Lake Superior.
				South, on east boundary of township 57 north, range 30 west.
118	1	61	75	Red sandstone.
	1	80	00	Var. 5 deg. 5 min. east.
	36	5	22	Var. 5 deg. 30 min. east; red sandstone on lake shore.
				North, on east boundary of township 59 north, range 30 west.
	36	00	00	Var. 5 deg. 45 min.; at 43 chains 50 links, var. 5 deg. 30 min. east; at 64 chains 86 links, var. 11 deg. 40 min. east. This line is over conglomerate rock.
				South, on east boundary of township 58 north, range 29 west.
	1	00	00	Var. 5 deg. 15 min. east; at 80 chains, var. 5 deg. 15 min. east
	1	57	50	Var. 1 deg. 30 min. east; at 63 chains 50 links, var. 5 deg. 30 min. east.
	12	45	75	Var. 6 deg. 10 min. east; at 49 chains, var. 4 deg. 10 min. east; at 61 chains 75 links, var. 7 deg. east.

Tabular statement—Continued.

No. of specimen.	On section	Distance.		
		Chs.	*lks.*	
119	12	50	50	Greenstone trap in ledge.
	12	69	00	Var. 1 deg. 10 min. west; at 71 chains, var. 1 deg. east.
120	13	21	25	Native copper and veinstone, loose in stream.
122	13	10	00	Amygdaloidal trap
121	13	23	25	Var. 15 min. west; native copper and veinstone and calcareous matter.
	13	28	00	Var. 1 deg. west; at 33 chains 75 links, var. 8 deg. east; at 43 chains 50 links, var. 1 deg. west chains, var. 7 deg. east.
	13	74	25	Var. 40 deg. west; at 80 chains, var. 4 deg. 30 min.
	24	21	75	Var. 1 deg. 30 min. east; at 24 chains 60 links, var west; at 40 chains, var. 4 deg. 15 min. east chains 75 links, var. 2 deg. east.
123	25	47	50	Trap rock, high ledge.
		35	50	Var. 2 deg. 15 min. east; at 40 chains, var. 4 deg. east.
				West, on south boundary of township 58 *north, range* 3
124	33	42	00	Trap rock, on point of ridge.
	31	00	00	Var. 3 deg. 35 min. east; at 40 chains, var. 6 deg. east.
125	36	44	00	Var. 5 deg. 20 min. east; greenstone trap, on a knob o
				East, on south boundary of township 58 *north, range* 3
126	31	29	50	Greenstone trap, in ledge.
	31	40	00	Var. 4 deg. 30 min. east.
127	31	75	00	Greenstone trap, on point of ridge.
128	32	8	00	Greenstone trap, on east side of hill.
	32	00	00	Var. 3 deg. 20 min. east.
129	32	13	00	Greenstone trap, on east end of ridge.
	32	40	00	Var. 5 deg. 40 min. east.
130	33	69	10	Greenstone trap in stream at falls.
	33	80	00	Var. 5 deg. east.
	35	00	00	Var. 4 deg. 20 min. east; at 40 chains, var. 5 deg. east; at 80 chains, var. 7 deg. east.
				North, on east boundary of township 58 *north, range* 3
131	36	68	00	Trap?
	36	27	00	Var. 8 deg. 35 min. east.
132	13	63	00	Trap, with many small veins of quartz.
		00	00	Var. 7 deg. 25 min. east.
133	13	64	75	Greenstone trap in ledge.
	12	00	00	Var. 6 deg. east; at 30 chains, var. 15 min. west chains, var. 3 deg. 45 min. east.
134	1	13	75	Ledge of trap rocks.
135	1	23	30	Conglomerate rock; at 40 chains, var. 6 deg. east.
136	1	27	75	Var. 8 deg. 40 min. east; conglomerate rock.
				North, on east boundary of township 59 *north, range* 28
137	36	36	00	Conglomerate ledge.
				South, on east boundary of township 58 *north, range* 28
	1	18	00	Conglomerate rocks, (ledge.)

Tabular statement—Continued.

No. of specimen.	On section	Distance.		
		Chs.	*lks.*	
	1	40	00	Var. 4 deg. 40 min. east; at 80 chains, var. 4 deg. 40 min. east.
	12	40	00	Var. 12 deg. 15 min. east; at 80 chains, var. 5 deg. 20 min. east.
138	13	53	00	Greenstone trap ledge 100 feet in height.
	25	00	00	Var. 5 deg. 40 min. east; at 49 chains 34 links, var. 3 deg. 35 min. east, at the Lake coast.
				West, on south boundary of township 52 north, range 35 west.
139	36	72	00	Var. 5 deg. 30 min. east; red sandstone in bed of stream.
	33	60	00	Var. 5 deg. 35 min. east; at 80 chains, var. 5 deg. 40 min. east.
				North, on east boundary of township 52 north, range 36 west.
140	1	32	25	Trap and altered sandstone, (near junction.)
	1	00	00	Var. 5 deg. 15 min. east; at 77 chains, var. 7 deg. 45 min. east; at 80 chains, var. 6 deg. 40 min. east.
141, 142	1	48	00	Amygdaloidal trap on ridge.
				West, on south boundary of township 53 north, range 36 west.
	36	40	00	Var. 1 deg. east; at 80 chains, var. 6 deg. 25 min. east.
	35	42	75	Var. 8 deg. 55 min. east; at 80 chains, var. 8 deg. 5 min. east.
143	33	50	00	Slaty sandstone, (argillaceous.)
				North, on east boundary of township 53 north, range 36 west.
144	36	43	00	Var. 5 deg. 20 min. east; trap, with amygdaloidal structure.
	36	60	00	Var. 6 deg. 45 min. east; at 56 chains 50 links, var. 10 min. east; at 59 chains 50 links, var. 8 deg. 40 min. east.
	13	00	00	Var. 7 deg. 15 min. east; at 80 chains, var. 7 deg. 5 min. east.
145	25	57	50	Argillaceous; ferruginous slate, turned out by a tree.
				West, on south boundary of township 54 north, range 36 west.
146	33	69	50	Sandstone, (altered;) loose flags in stream.
	33	00	00	Var. 7 deg. 10 min. east; at 80 chains, var. 7 deg. 10 min. east.
				West, on south boundary of township 55 north, range 36 west.
147	35	72	30	Red sandstone, left bank of stream; dip 8 deg. northwest.
	35	00	00	Var. 6 deg. 50 min. east; at 80 chains, var. 6 deg. 55 min. east.
				West, on south boundary of township 51 north, range 37 west.
	32	00	00	Var. 5 deg. 30 min. east; at 80 chains, var. 4 deg. 15 min. east.
148	31	8	00	Trap rock, (in ridge.)
				West, on south boundary of township 52 north, range 37 west.
149	36	57	00	Trap rock of an amygdaloidal structure in ridge.

Tabular statement—Continued.

No. of specimen.	On section	Distance. Chs.	lks.	
	36	00	00	Var. 5 deg. 15 min. east; at 40 chains, var. 4 deg. at 52 chains, var. 15 min. west; at 80 chains, v deg. 10 min. east.
	35	40	00	Var. 4 deg. east; at 80 chains, var. 1 deg. 35 min. eas
	34	40	00	Var. 3 deg. 5 min. east; at 53 chains 55 links, var. 8 15 min. east; at 80 chains, var. 8 deg. 15 min. eas
	33	40	00	Var. 7 deg. 15 min. east, near junction of sandstone trap rocks.
				North, on east boundary of township 52 *north, range* 37
150	36	78	00	Amygdaloidal trap rock.
	36	00	00	Var. 5 deg. 15 min. east; at 80 chains, var. 5 deg. 35 east.
	24	00	00	Var. 6 deg. 30 min. east; at 40 chains, var. 8 deg. eas
	13	00	00	Var. 7 deg. 45 min. east; at 80 chains, var. 7 deg. 15 east.
				West, on south boundary of township 53 *north, range* 37
151	35	54	50	Red sandstone; some changed.
	35	00	00	Var. 7 deg. 10 min. east; at 40 chains, var. 7 deg. 5 east; at 80 chains, var. 7 deg. 5 min. east.
				Township 53 *north, range* 38 *west.*
152	16	00	00	On lake shore, northwest side of a point, micaceous stone; also red sandstone.
				North, on east boundary of township 51 *north, range* 38
	36	40	00	Var. 5 deg. 5 min. east; at 80 chs., var. 5 deg. 45 min.
	36	58	00	Knob of trap rocks.
154	25	9	50	Knob of trap rocks on top of hill.
	25	40	00	Var. 7 deg. east; at 80 chs, var. 5 deg. 15 min. east.
153	24	27	00	Trap rock; ledge on north side of hill.
	24	40	00	Var. 6 deg. 20 min. east; at 80 chs., var. 7 deg. 30 east.
				West, on south boundary of township 51 *north, range* 38
155	35	9	50	Amygdaloidal trap and altered sandstone.
	35	40	00	Var. 5 deg. 40 min. east; at 80 chs., var. 6 deg. 15 east.
	34	19	00	Var. 50 min. east; at 25 chs. 25 lks., var. 7 deg. 10 east; at 40 chs., var. 2 deg. 10 min. east.
156	34	40	50	Trap rock ledge, (amygdaloidal.)
	33	00	00	Var. 5 deg. 50 min. east; at 80 chs., var. 6 deg. 15 east.
				West, on south boundary of township 51 *north, range* 39
157	33	74	00	Red clay in right bluff of the Ontonagon river.
	33	00	00	Var. 6 deg. 25 min. east; at 80 chs., var. 6 deg. 35 east.
				North, on east boundary of township 51 *north, range* 39
158	36	52	10	Red sandstone (some changed.)
	36	00	00	Var. 6 deg. 45 min. east; at 80 chs., var. 6 deg. 50 east.

Tabular statement—Continued.

No. of specimen.	On section	Distance. Chs.	lks.	
				West, on south boundary of township 51 north, range 40 west.
159	32	76	15	Micaceous red sandstone; dip 10 deg. northerly in bank of stream.
	32	00	00	Var. 5 deg. 35 min. east; at 80 chs., var. 5 deg. 20 min. east.
				West, on south boundary of township 51 north, range 41 west.
160	36	31	00	Micaceous sandstone; loose flags in stream.
	36	00	00	Var. 4 deg. 45 min. east; at 80 chs., var. 4 deg. 50 min. east.
	31	00	00	Var. 5 deg. 55 min. east; at 40 chs., var. 6 deg. 25 min. east; at 80 chs., var. 7 deg. east.
				North, on east boundary of township 51 north, range 42 west.
161	36	80	00	Var. 6 deg. 55 min. east; 5 chs. west of line in stream, argillaceous slate; dip 11 deg. east-northeast.
162	13	10	00	Var. 7 deg. 12 min. east; 8 chs. west of line in Iron river, argillaceous slate.
163	13	12	00	Agillaceous slate and slaty sandstone in Iron river.
164	13	15	00	Same west of line in river.
	13	58	00	9 chains west to falls of Iron river.
165	13	53	00	¼ mile up Iron river, argillaceous slates and slaty sandstone.
				West, on south boundary of township 51 north, range 42 west.
166	36	19	20	Slaty sandstone (argillaceous) in stream.
167	35	4	15	Var. 8 deg 35 min. east; argillaceous slaty sandstone, (Iron river.)
168	33	32	00	Trap?
	33	40	00	Var. 8 deg. 35 min. east; at 80 chs., var. 8 deg. 40 min. east.
169	33	54	50	Trap rock of an amygdaloidal structure.
170	32	22	50	Amygdaloid trap in ledge.
171	32	45	50	Var. 8 deg. 15 min. east; compact trap southeast side of hill.
172	31	25	50	Brick-colored trap rock; bank of stream (compact.)
	31	40	00	Var. 7 deg. 55 min. east; at 80 chs., var. 8 deg. 10 min. east.
				North, on east boundary of township 51 north, range 43 west.
173	25	31	00	Compact trap rock.
	25	40	00	Var. 8 deg. east; at 80 chs., var. 8 deg. 35 min. east.
174	13	25	00	Altered sandstone.
	13	40	00	Var. 8 deg. east.
175	13	61	00	Altered sandstone.
176	12	41	55	Calcareous spar; and veinstone from a vein.
				West, on south boundary of township 51 north, range 43 west.
177	35	53	00	Compact trap rock south side of hill.
178	33	23	00	Trap rock with an amygdaloidal structure.
	33	69	75	Trap ledge 80 feet in height.
179	34	40	00	Var. 7 deg. 20 min east; light-colored compact trap rock.
180	32	25	00	Light-colored (nearly perpendicular) ledge 200 feet high.
	32	57	50	Same on southwest point of hill.

GEOLOGICAL REPORT OF BELA HUBBARD, DEPUTY SURVEYOR.

ieral observations upon the geology and topography of the district uth of Lake Superior, subdivided in 1845 *under direction of Douglass loughton, deputy surveyor.*

he subdivisions embrace the following townships, which are fully pleted, and the notes and maps whereof are herewith returned.

ownship	46	north,	ranges	24, 25, and 26 W.
"	47	"	"	24, 25, and 26 W.
"	48	"	"	25 and 26 W.
"	51	"	"	32 and 33 W.
"	53	"	"	32 and 33 W.
"	54	"	"	32 and 33 W.
"	55	"	"	31, 32, 33, and 34 W.
"	56	"	"	30, 31, 32, 33, and 34 W.
"	57	"	"	29, 30, 31, 32, and 33 W.
"	58	"	"	26, 27, 28, 30, and 31 W.
"	59	"	"	27, 28, and 30 W.

he notes and maps of township 58 north, ranges 29 and 32 west, and ıship 59 north, range 29 west, were in possession of Dr. Houghton, were lost with him.

or our present purpose the above named townships may be arranged vo divisions, which, from their different geological features, will be rately considered.

ı the first will be included townships 46, 47, and 48, ranges 24, 25, and

In the second division the townships upon the Keweenaw penin-, township 48, in ranges 25 and 26, and all those of our second divis- are within the *township line* surveys of the past season, and the gen- features of their topography and geology are exhibited with great picuity and accuracy in the report of Wm. A. Burt, esq., accompany- the returns of his surveys. I shall therefore, as far as possible, avoid petition of facts which appear sufficiently detailed by him.

Primary and metamorphic region.

ranite rocks.—The portion of country included in our first division ch is occupied by these rocks, embraces township 46 north, ranges 25, and 26 west, together with most of the lower tier of sections in the ıships adjoining on the north.

hroughout this region the granite rocks make their appearance in a ession of rounded knobs, elevated from 20 to 100 feet above the sur- ding country, and from 300 to 800 feet above the level of Lake Supe- and having a general range a little south of west and north of east. se rocks vary much in character and composition, being sometimes blendic and approaching a perfect sienite, but more commonly athic, or composed of quartz and felspar, in which the latter mineral ominates. In the more southerly portion of the district, the felspar is nd gives a predominant color to the rock; occasionally the granite is ersed by quartz in irregular veins. Some portions are massively strati- the masses dipping to the north, or nearly vertical. The knobs are

e metamorphic region, the altered nature of the rocks plainly indi-
ates the near approach of an igneous rock to the surface; and the dip of
e rocks, though mainly north, at a high angle exhibits a tendency in
l directions from a central axis.

These rocks are throughout pervaded by the argillaceous, red, and mi-
aceous oxides of iron—sometimes intimately disseminated, and some-
nes in beds or veins. These are frequently of so great extent as almost
entitle them to be considered as *rocks*. The largest extent of iron ore
ticed is in township 47, range 26, near the corner of sections 29, 30,
, and 32. There are here two large beds or hills of ore, made up almost
tirely of granulated, magnetic, or specular iron, with small quantities
spathose and micaceous iron. The more northerly of these hills ex-
nds in a direction nearly east and west for at least one-fourth of a mile,
d has a breadth of little less than 1,000 feet; the whole of which forms
single mass of ore, with occasional thin strata of imperfect *chest* and
sper, and dips N. 10° E. about 30°. At its southerly outcrop, the ore
exposed in a low cliff, above which the hill rises to the height of twenty
thirty feet above the country on the south. The ore here exhibits a
ratified or laminated structure, and breaks readily into sub-rhomboidal
agments in such manner as will greatly facilitate the operations of quar-
ing or mining the ore.

This bed of iron will compare favorably, both for extent and quality,
ith any known in our country. The largest of the large iron ore beds
the State of New York is estimated to be but 700 feet in breadth by
,000 in length. A more extended and minute examination will proba-
y determine this portion of the metamorphic group to contain other
es, less in amount, but which are generally esteemed more valuable.

The northerly portion of the metamorphic group of rocks, and which
ay here be denominated the *trappean* portion, embraces the whole re-
ainder of the group north of the portion last described, except a small
act of country occupied exclusively by clay slate rock, and whose extent
ill be hereafter noticed. This division of the metamorphic region is
haracterized by the frequent occurrence of knobs or uplifts of greenstone
d augitic trap, making their appearance rather irregularly over the
ountry, and surrounded by altered sandstones and slates. These uplifts
e doubtless disconnected from any common centre or focus of eruption;
t it is evident that rocks of igneous origin form the base of all the rocky
evations of the region, and the surrounding altered and slaty rocks flank
eir sides and dip in all directions from them—the trap being protruded
to a series of low knobs. Around the bases of these are the metamor-
ic rocks, consisting mostly of talcose, chloritic and clay slates. Quartz
ms comparatively a small proportion of these rocks. The prevailing
p is northerly about 80°. Several of these knobs in township 48,
nge 26, attain an elevation of 1,058 feet above Lake Superior.

A hill of tolerably well defined granite makes an outcrop near the cen-
e of this region, and in a low ridge bearing in an easterly and westerly
rection about two miles; but the granite is evidently of trappose charac-
r. The hills of this region are generally timbered to their summits; and
many of them the rock does not come to the surface. The country is
general moderately rolling and beautiful. The timber is chiefly sugar-
aple, yellow birch, fir, hemlock, and spruce; and the soil will without
ubt prove fertile.

ly, their character as distinct ranges is almost entirely lost, until eappear at about an equal distance from the Portage lake on the side of the basin. The continuity of the trap rocks, however, is not yed, though its bounds are much narrowed.

barometer work having been carried no further west from the ex- y of the point than range 29, does not enable me to give the eleva- of these ranges with completeness; but it may be stated that the t point found is in the southerly range, in township 58, range 29, the trap rises into a knob, having an elevation above Lake Supe- 876 feet. To this knob has been given the name of Mount ton. The general elevation of the northerly range of hills is, how- somewhat the greatest, the knobs rising to from 400 to 600 feet.

se ranges present their steepest escarpments on their southerly sides, they rise frequently into cliffs of 100 feet, nearly perpendicular, one instance, on the southerly range, to nearly 400 feet. In gen- ey slope much more gently to the north, thus following the general ation or dip which is common to all the rocks of the point, in that on.

portion of the trap district included between these two ranges, as sterly as range 30, has a gradual descent into the valley of the Montreal river. Beyond this, westerly, it is more rolling, and imes broken by knobs and ridges of trap, with some intervening os. The whole is, in general, covered by a sandy loam, and is d with an abundant growth of sugar-maple, birch, fir, oaks, and pine; the maple greatly predominating wherever the soil is of suffi- lepth. Where the soil is barely sufficient to conceal the underlying cedar is the prevailing timber.

ill be observed that the Little Montreal river, above alluded to, has rse wholly between these two trap ranges, pursuing its course across ranges 30, 29, and 28. This is the most considerable in the district under consideration. Though somewhat sluggish h the first half of its course, which may be said to occupy the levated part, or plateau, of the trap region, it becomes more rapid h ranges 29 and 28, and its course to the lake shows a very con- ble descent, probably of about 300 feet, through the latter range.

more northerly of these ranges of trap is very uniform in char- and while the rock of both ranges may be denominated greenstone, the latter is much the most compact. The rocks of the former have a very distinctly crystalline structure, passing from a very ated greenstone to a rock composed of crystals of augite, or horn- and felspar, with considerable intermixture of quartz; sometimes forming an imperfect sienitic granite, and showing the identity of of the trap and granite rocks. These portions of the trap are ex- y hard, and break with difficulty under the hammer.

central portion of the more elevated knobs of the southerly range quently composed of a very hard and compact trap of reddish color, sometimes takes on the character of a trap breccia, or aggregate of cemented angular pieces of rock, and may, perhaps, be denominated porphyry.

rmediate between these two ranges the trap is sometimes compact, ers amygdaloidal, and occasionally granular; while on the outer of both ranges it is almost uniformly amygdaloidal, and it is fre-

and conglomerate and sandrock, lie several long and narrow lakes, and narrow lines of swampy ground are not an uncommon feature.

The barometer work having been carried over a comparatively small portion of the point, I have not been enabled to form any new estimate of the thickness of the conglomerate and mixed rocks. Those contained in the report of Dr. Houghton, of 1841, made to the legislature of Michigan, may be considered as sufficiently precise, which fix the maximum of the latter at 4,200 feet; the former having probably a less thickness on the point, though attaining near the Montreal river a thickness of 5,260 feet.

Trap dikes.

I have already alluded to the fact that the granites of the more northerly portion of the primary district are traversed by dikes of trap, which have produced great changes in the rocks of that district, as also to the fact that the conglomerate and sandrocks are found traversed by similar dikes. On approaching Keweenaw point from the eastward, trap is seen apparently interstratified with conglomerate and mixed rocks, which constitute the coast, the whole dipping together to the north and northeasterly, at an angle varying from 30° to 45°.

A trap dike of very unusual size makes its appearance on the eastern extremity of the point, in section 10, and may be traced westerly, following the general curvature of the coast, into township 31 west. It has an average breadth of half a mile. In its westerly prolongation, this dike first approaches the coast at Copper Harbor. It has here been broken across by the waters of the lake, so that while the conglomerate rocks are found composing the outer points, as well as the south side of the harbor, the trap is seen at its two ends and at the projecting points and islands, and it forms the bar across the entrance.

Continuing westerly, this dike cuts entirely across the conglomerates and sandrocks at Agate Harbor, and from thence the coast is constituted of this rock westerly as far as section 3, township 58, range 31. Along this portion of its course it is found gradually thinning out, having at Grand Marais and Eagle Harbors a width of a few rods only, and thinning out entirely, or passing off into the deep water of the lake, at the point above named.

The trap composing this dike is partly compact and partly of amygdaloidal structure. At Agate Harbor the trap is of this latter character, and the cells are filled with chalcedony, cornelian, jasper, quartz, &c., often forming agates of great size and beauty. This part of the coast is lined with islands at a few rods distance from the main shore, most of which appear to be portions of the trap of a more hard and compact character, and which have resisted the action of the waters that have washed away the intermediate portions, thus forming a series of narrow and deep channels. This dike dips regularly with the conglomerate and sandrocks in which it is included, to the north and northwest, at an angle of about 45°.

Red sandrock.

This rock, the equivalent of the Potsdam red sandrock of the New York reports, it will be seen by the map, occupies the whole remainder of the portion of Keweenaw point under consideration, skirting a large part of

the trap range on both sides, but having by far its broadest extension o the south side. It here lies in nearly horizontal strata, though at the cont a slight dip inland is observable, becoming more apparent as it approache the basin of Portage lake. In its approach to the trap, however, it is found more or less tilted from its original horizontal position, and is also very much altered by its contact with that igneous rock. The evidence both of the deposition of this extensive rock formation in calm and shal low waters, and of the subsequent change induced in it by the trap rock when in a fused or heated state, are very apparent.

Receding from the trap ranges southward, the surface of the coun underlaid by this rock is in general rolling, and timbered with sugar m ple, hemlock, birch, spruce, fir, and occasional large pines. The soi a sandy loam, and in general of good quality. Approaching the L coast the land falls gradually to a level, where the evergreens predomi over the maple, and the country is much cut up by marshes.

Mineral veins.

In regard to this subject I have deemed it unnecessary to enter details, for the reason that the returns of the surveys, so far as the geol is concerned, relate rather to the general characteristics of the region; that the observations of the past season, so far as can now be determin tend to confirm the facts which have been stated with considerable nuteness of detail in the report made by Dr. Houghton in 1841 to legislature of the State of Michigan.

It may, however, be observed that the courses of many veins have b fixed with accuracy, and the veins themselves traced in some instan for several miles across the conglomerate and sandrocks, and into a across some portions of the trap. The observations there made are co firmatory of the fact first noted by Dr. Houghton, that the true veins the district referred to pursue a course nearly at right-angles to the line bearing of the trap range.

General remarks.

In concluding these brief descriptions, it may be proper to state t the personal observations of the writer have been confined almost tirely to a somewhat cursory exploration, made several years ago wh acting as assistant to Dr. Houghton in his arduous labors in the geologi commission of Michigan, and that he has been enabled to devote bu very limited time to the labor of an examination of the specimens c lected, and of the notes returned. It is very probable, therefore, that may have fallen into some errors, or at least have omitted many facts importance. It is only by special solicitation, and the apparent necess of the case, that he has undertaken to prepare such general observati as seemed called for under present circumstances.

In attempting this duty the undersigned cannot be unmindful of very meagre and imperfect sketch here presented, when compared w whatever proceeded from that master-mind whose genius first develope and whose indomitable energy tracked through all its difficulties, a sy tem not only intricate in itself, but novel to science, and in a region that time destitute of all the ordinary facilities for scientific investigation

same active and philosophic mind we owe the system of the
f geological with the lineal surveys of lands of the United States,
experimental results of which are now returned to this depart-

esenting these, it may not be deemed inappropriate to allude to
eral advantages resulting from the new system, as devised and
successfully prosecuted by Dr. Houghton.
dvantages of thorough geological and topographical surveys are
well appreciated, that they have been prosecuted to considerable
y foreign governments. Great Britain has already appropriated
sums towards the accomplishment of a complete survey of that
, which has as yet advanced but a comparatively little way;
geological surveys made by the United States, and by several of
s, have made very fully and generally known the advantages of
dertakings. Fortunately, the system of rectangular survey-
ted by the United States government affords the best possible
ity to accomplish with little additional expense, what, under
umstances, could be effected only at a much more considerable
he maps, both geological and topographical, herewith returned,
d some evidence of the extreme accuracy, as well as extent and
ss, of the results thus obtained.
icing some of the scientific results of the surveys of the past
ne duty would be imperfectly performed were I to omit calling
to the unwonted accuracy with which the lines have been run.
racy has been attained by the exclusive use, by all the parties,
's Solar Compass," an instrument too well known to need more
re allusion, but the great value of which has been more than
firmed during the surveys of the past season. This remark will
ified when it is considered that nearly the whole region of coun-
sed by these surveys abounds with mineral attractive to the
that the needle has been almost constantly operated upon by
hich produced deviations from the true meridian of the earth's
m, and often so powerfully as to completely reverse the direction
es. A variation fluctuating from 6° to 20° on either side of the
idian was not uncommon, through the length of an entire town-
d it seems difficult to imagine how the lines could have been run
ordinary surveyor's compass. Other important advantages have
ived at from the use of this compass, of both a scientific and prac-
aracter, one of which only will be here alluded to, viz: the means
by it of detecting the presence of certain rocks over large areas
o rocks are visible at the surface. This was particularly observ-
the region of the great trap ranges, where it was almost uniformly
hat the needle became deflected towards the mass of the trap hills,
ough distant, and was more or less fluctuating when passing over
y whose underlying rock was trap. The same phenomena were
d among the iron ore rocks of the metamorphic region.
ion may here be made to the increased importance given to the
the past season by the introduction of the barometer upon the
y means of which the elevations of the country are exhibited with
legree of accuracy; a complete section being obtained on every
l thus furnishing all that was needed to make a true, complete, and
exhibit of the topography of the country. In another and more

also deep valleys of streams, many of which have ledges on their sides. These general characteristics are often changed for cedar, spruce, or tamerack swamps, which are most numerous in townships 46, 47, and 48 north.

The remaining portion of the survey, which lies south of township 45 north and east of range 32 west, is somewhat diversified in character. That part occupied by granitic rocks is rough and broken; the rest is generally undulating and rolling. There are, however, some deep valleys and high ridges; also tracts of level land; and the whole is interspersed with many cedar, spruce, and tamerack swamps.

Streams and lakes.

The Esconawba, Peshakumme, Mesquacumecum, and Menomonee rivers, the waters of which fall into Lake Michigan, and the Sturgeon river, falling into Lake Superior, are the principal streams of the district above described. Their sources are generally either swamps or lakes, and, as they wind their courses through the district with intervals of gentle and rapid current, they frequently pass through other lakes and down ledges of rocks by rapids or falls of various heights, which form good sites for hydraulic power.

The largest of the falls of the Peshakumme river is a few chains above its junction with the Menomonee river, and is estimated at 24 feet. At this place a depot of provisions was made, from which supplies were obtained by the packmen for nearly the whole survey; and, to facilitate their movements, two trails were marked from the depot—one northeasterly, about 18 miles to the east boundary of township 43 north, range 29 west; and the other northwesterly to the south boundary of township 42 north, range 31 west.

This river is frequently ascended by the Indians in bark canoes, making many portages into the west part of township 48 north, range 31 west, from which place a portage trail leads to Keweenaw bay of Lake Superior.

The Mesquacumecum river is also frequently ascended by the Indians in birch bark canoes, into township 46 north, range 34 west, from which place a trail leads to Keweenaw bay; and the Brula river is ascended in like manner into Lake Brula, from which two trails lead to Keweenaw bay—one direct; the other by way of Lac Vieux desert.

Fort and Cedar rivers in the southeast part of the district, and Dead river in the northeast part, are streams of minor importance, with alternating, gentle, and rapid currents, and with but few falls suitable for hydraulic purposes. The best falls for such purposes that were observed on these streams may be found on the west branch of Cedar river, a few chains north of the south boundary of township 42 north, range 28 west, on the southeast quarter of section 31.

As some of the sources of all the above-mentioned streams are in swamps, they are more or less colored by vegetable matter; but the quality of their water is proved to be good by the multitudes of speckled brook trout that are found in them, weighing from half a pound to two pounds each.

Lakes Brula and Chegagon, and many others, have deep and clear water.

Soil and timber.

The soil of the uplands of this district is generally a sandy loam, and on the most elevated places it is thin, in consequence of the near approach of the rocks to the surface. In some places, the rocks are bare; in others, only covered with moss and vegetable matter. With this exception, the soil is for the most part sufficiently deep and rich to be productive, and in some of the valleys it is of very good quality. But the soil of the spruce-pine plains, delineated on the map, is light and sandy.

The upland is variously timbered with sugar tree, white and yellow birch, hemlock, fir, pine, spruce, cedar, ash, ironwood, &c.; and the swamps are timbered with white cedar, spruce, tamerack, and alder.

On nearly all the small streams, old beaver-dams are frequently found, a portion of which have been removed by the floods, since their original builders and supporters have been taken by the hunters. A few beaver, however, have escaped their pursuers, and now peaceably maintain their works.

Many of the drained beaver-ponds have become meadows, from which several tons of bluejoint or marsh grass may be annually cut. These meadows are often bordered by alder thickets.

The best portions of this survey for agricultural purposes are the following townships, viz:

Townships	42	north,	in ranges	32, 33, 34, and 35 west.
"	43	"	"	32, 33, 34, and 35 "
"	47	"	"	27 and 28 "
"	48	"	"	27 and 28 "
"	49	"	"	32, 33, 34, and 35 "
"	50	"	"	29, 30, 31, 32, 33, 34, and 35 west.

Making twenty-three townships.

Descriptive geology.

Before entering upon the descriptive geology of the district surveyed, it may be useful to take a brief view of the extent of the geological formations and system of uplifts of which this district forms a part, and its position in relation to the same.

Extract from Professor Hitchcock's Elementary Geology, 1845, pages 329, 330:

"On the north shore of the St. Lawrence are two ranges of mountains, running parallel to the river—one at the distance of 15 or 20 miles, and the other 200 miles distant. On the west side of Lake Champlain is a remarkable development of these mountains, in Essex county, in New York, where they rise to the height of 5,400 feet.

"From Essex county, these mountains stretch to Kingston, in Upper Canada, where they become blended with another low range, which has been traced along the northern shore of Lakes Ontario and Huron, and to the west of Lake Superior, and probably extend nearly or quite to the Rocky mountains.

"The mountains in Essex county, on the west of Lake Champlain, are composed chiefly of Labrador felspar and hypersthene rock, similar to the rocks in the northern part of Lower Canada and the coast of Labrador; and a similar rock is found north of the lakes in Upper Canada,

l occupying a large space south of Lake Superior, in the western (north-
ı) peninsula of Michigan; so that probably they may form a connected
ıge almost to the Mississippi. Nearly all the rocks in Upper Canada
ɔear to be primary."

The district surveyed is situated on the southerly side of this widely-
ended range of primary rocks, south of Lake Superior, between lati-
les 45° 53' and 46° 45' north, and upon the most elevated region be-
ɔen Lakes Michigan and Superior; and, with small exceptions, it varies
height above the surface of these lakes from 400 to 1,200 feet, and
m the lowest points in the basins of Lakes Michigan, Huron, and Su-
ɔior from 2,200 to 3,000 feet.—(See Geological Report of Michigan,
39, pages 51, 53, 54.)

These depressions, though filled with fresh water to the depth of 1,800
ɛt or more, are 1,200 feet below the surface of the Atlantic, and being
ɛrefore the more wonderful and interesting, should be taken into con-
leration in estimating the inequality of the land surface of this region.
It may be worthy of note here, that these great lakes are situated along
in the vicinity of the southern limit of the great primary range of rocks
ove referred to.

Leaving these general remarks, the geological features of the district
rveyed will be considered.

This district, as before observed, is bounded north by the fifth correc-
n line, south by the fourth correction line and the Brula river, east by
ıges 23 and 26, and west by range 37, embracing about one hundred
wnships of land, mostly over primary rocks, which may be regarded as
ɔoutherly portion of the great system of uplifts of primary rocks already
ɛrred to. Specimens of the principal rocks and minerals found in
ery part of this district have been collected, and their names and locali-
s are entered in the tabular statement at the close of these remarks.
This will avoid much detail in regard to the character and boundary of
ɛ various rock formations within the district.

Within the boundaries of this survey are found, occupying areas of
rious dimensions, granite and sienite, talcose and argillaceous slates,
ɛenstone and hornblende slate, mica slate and gneiss, coarse sandstone,
ciferous sandstone, encrinal limestone, red sandstone and red clay,
ft, magnetic iron ore, &c., which will be briefly described in the order
re given. The boundaries and localities of the above named rocks are
ıwn in colors and named on the map accompanying this report.

Granite and sienite.

These rocks occupy an area of about twenty-two townships on the
rtheast part of the survey, between the fifth correction line and the
ıth boundary of townships 45 north, and east of range 32 west, in a
ies of irregular uplifts, frequently forming high cliffs and sloping ledges
the most elevated portion of this district. They also occupy a small
ıce, mostly in townships 41 north, in ranges 28 and 29 west.—(See map.)

These rocks gradually pass into each other, and are quite variable in
ɛ proportions of their mineral composition. The middle portion of the
ınitic uplifts is composed of quartz, felspar, mica, and hornblende,
ɛre or less granular. In some places it is quartzose, in others fel-
ıthic, of a gray or reddish color. The most prevailing exceptions to

this is an increase of hornblende, and a decrease of mica, forming a sienitic granite. A still further change is seen on the northerly portion of the granitic range, where the rocks are composed of quartz, felspar, and hornblende, forming a sienite. In some ledges the hornblende is much increased, and the rock becomes a sienitic greenstone. This variety sometimes passes into a hornblende rock.

In addition to the above varieties, there was found in a few places a granulite composed of quartz and felspar, and less frequently massive quartz and felspar.

A gneissoid structure of the above described rock was often visible; also quartz veins were frequently seen from a line to two feet or more in width, and not unfrequently veins and dikes of trap. In fact, the observer will not fail no notice the trappose appearance of the rock in many places.

Talcose and argillaceous slates.

These slates are best developed on the metamorphic district, within the granitic range already described—townships 47 and 48 north, ranges 27, 28, and 29 west, (see map)—and argillaceous slates in parts of township 42 and 43, ranges 29, 30, 31, 32, 33, and also in the north part of township 50 north, ranges 32 and 33 west. The first of these is an extension of the metamorphic rocks, referred to in my geological report of 1845, on and in the vicinity of Dead river of Lake Superior. On this survey, these rocks are bounded by the granitic on the north, west, and south, and taken in connexion with those described in 1845, form a group nearly or quite surrounded by them, into which they pass by an almost insensible gradation. They dip variously at a high angle, generally conforming to the surrounding granites, or flanking the numerous protrusions of greenstone within their boundary. They appear like the remnants of overlying rocks among the greenstone, which have escaped the denuding effects of causes that partially stripped this region of similar rocks previous to the completion of its present elevation.

The talcose slates are of many varieties, such as would result from their passing into argillitic and into hornblende slates. Steatite, associated with magnetic iron, was found on the south boundary of township 48 north, range 28 west, 17.50 west, on the south side of section 35. For the localities of various rocks, &c., see tabular statement.

On this part of the survey quartz veins were frequently seen traversing the rocks, but no one was observed to be metalliferous. Magnetic iron ore in beds, however, abounds here, and will be described further on.

The argillaceous slates alluded to in townships 42 and 43 north, are generally overlaid by deep drift; their boundary, therefore, could not be satisfactorily defined. West of the Peshakumme river these slates appeared to have undergone considerable change by igneous action, and were often associated with an oxide of iron; but east of the Peshakumme no change by igneous action in the slates was observed, and on this part they have generally a reddish color.

They dip variously at a high angle, and are supposed to conform to the greenstone on the north and west, and to overlie or pass into the mica slates on the south; and in their middle portion they dip about 90°, with strike nearly east and west.

The other locality of argillacous slates, as before mentioned, is found n the north part of township 50 north, ranges 32 and 33 west.—(See map.) These slates are also overlaid with deep drift; their boundary, therere, may not be very accurately defined on the map. They are of a dark own color, and generally dip to the northwest. They appear to pass to hornblende slate on the south, and into novaculite or whetstone ate on the north; on the west they are probably in junction with the d sandstone.

Greenstone and hornblende slate.

These rocks occupy a larger area in the districts surveyed than any her class of rocks. They extend from the granitic and other rocks east f them, westward beyond the survey.—(See their outline on map.)

The greenstone and hornblende slates form a less broken surface than e granitic range; and next to it is the most elevated range on this disict, having an estimated altitude, in many places, of from 1,000 to 1,100 et above Lake Superior.

These rocks are frequently seen in the beds and banks of streams, and ridges and conical hills of various heights, often forming precipitous dges upon their sides.

The greenstone of this region is generally more or less granular and enitic, with a dark green color when moist; its composition is hornende, felspar, and quartz—the former mineral greatly predominating. some places the felspar and quartz are nearly or quite wanting, leavg a granulated hornblende rock. Another variety of this rock was freiently seen, which is composed of the same ingredients, but very fine ained and compact, and having frequently a laminated or slaty structre, the cleavages of which generally dip from the granitic rocks at a ry high angle.

Some of these hornblende slates have in their seams and cleavages a ky lustre, from the presence of mica or talc in very fine grains.

All of these rocks are traversed by many quartz veins, from a line to ur feet or more in width, and with still larger veins and dikes of more cent trap rock. This range is supposed to become blended with the ap range of Keweenaw point as it passes under the red sandstone lying tween them, and probably further west the two are united in one range.

Mica slates.

These slates stretch along the southerly side of the argillaceous slates n the south part of the survey. They extend from the Brula river on a ourse ENE. for about 22 miles, in townships 41 and 42 N., ranges 29, 0, 31, and 32 W., and have an average breadth of about four miles. See map.)

The mica slates are supposed to dip northerly under the argillaceous ates at a high angle, varying at the surface from 45° to 80°.

This rock is composed of mica, quartz, and felspar. Its laminæ are ndulating or waved; but its cleavages, on a large scale, are even and regular.

These mica slates are best developed on the south boundary of townip 42 N., ranges 31 and 32 W., in the beds and banks of the Pesha-

kumme and Mesqua-cum-a-cum-sepe, and at the falls near the junction of the latter stream with the Brula river.

These slates gradually pass into hornblende slate, or a rock resembling greenstone on the south, and in their extension east of the Peshakumme river they gradually change to the character of gneiss, until lost under the sandstone east of it.

Coarse sandstone.

This sandstone commences on the west, at the easterly extension of the mica slates, where it is much changed by igneous action; it flanks the greenstone and granites on the northwest, and dips under or passes into the calciferous sandrock on the southeast. This is a coarse quartose, generally reddish, but in some places mottled, in others of a yellowish white. It is generally overlaid by deep drift, and therefore not seen under circumstances sufficiently favorable to determine its strike and dip accurately; and for the same reason the boundaries of this rock, as drawn on the map, can only be considered as an approximation to accuracy.

Calciferous sandstone.

The northwesterly boundary of this rock flanks the above described sandstone, and the greenstone and granites, on the southwest; it dips moderately SSE., and gradually passes into or under the encrinal limestone on the southeast, having a breadth of about 13 miles on the east boundary of range 27 W.—(See map.)

This calciferous sandrock nearly runs out near the south boundary of township 42 N., ranges 27 and 28 W., where it gradually loses its character, and is interrupted by a protrusion of granite, which extends southwest over the 4th correction line. To the southeast of the granites the calciferous sandrock maintains its character, but the narrow strip on the northwest of the granite is nearly destitute of lime, and appears like a coarse sandstone. No fossils were discovered in this rock.

Encrinal limestone.

This limestone flanks the above described calciferous sandstone, and occupies the remainder of the district surveyed in a southeasterly direction, and in that direction extends nearly or quite to Green Bay. This is a valuable lime rock—well stratified and jointed—and has a moderate dip SSE. Its fossils are encrinites, orthocra, fucoides, and other marine shells.

It may be worthy of note here, that it is supposed that the igneous rocks approach near the surface of the lime rocks in several places, from the fact that the lime rock dips, in some places, with an unusual angle in all directions, within the space of one mile or less; and also from the great aberrations of the needle on and about these places. On the south boundary of township 41 N., range 27 W., section 36, the magnetic needle was turned, by local attraction, in every possible direction.

This probably indicates that the igneous or metamorphic rocks, with a bed of magnetic iron ore, are near the surface.

Red sandstone and red clay.

e red sandstone of Lake Superior is supposed to occupy a small space
northwest corner of this district, which lies too low beneath a deep
te of red clay and sand to be seen, except in a few places; it is,
ore, difficult to define its junction with the greenstone and slates on
ntheast.—(See map.)
clay is often seen on this part of the survey in the banks of deep
s and valleys of streams, overlaid by a deposite of silicious sand, of
imated average depth of 70 or 80 feet.
t the sandstone above named rests upon the greenstone trap, is in-
from the protrusion of this rock in several places through the above
ned deposites; the most remarkable one of which is known by
me of Silver mountain, situated on the east boundary of township
, range 36 W., on the line between sections 1 and 6. This is an
d knob or hill of 200 or 250 feet in height, having an area at its
f about 200 acres; the southeasterly side of which is mostly a
precipice, from 25 to 120 feet in height, but its northwesterly side is
s precipitous.
s mountain-like mass of greenstone trap is, to some extent, metal-
s; in nearly every part, traces of the gray sulphuret of copper were
ut no well-defined and productive vein was found. On its south-
y side two or three imperfectly formed veins of quartz and calca-
par were seen associated with the gray sulphuret of copper; and in
laces, with slight traces of green carbonate of steatite.
geon river also passes over trap rocks, by falls and rapids, about three
SSE. of Silver mountain, in township 49 N., range 35 W.

Drift.

drift of this district is composed of sand, gravel, and boulders—
ally derived from the rocks which abound here, and to the north-
f this survey the latter is found of various sizes, from a few inches
eet or more in diameter.
spruce-pine plains delineated on the map have a deep deposite of
s sand, which appears in a more stratified order than the ordinary
f this region of country.

Iron ore beds.

rteen beds of magnetic iron ore were found within this survey, lo-
s follows:
first bed discovered of this ore was found while travelling from the
kumme falls, near the Menomonee river, east to Fort river, before it
irveyed in May last, but was not discovered again during the sur-

believed, however, that this bed of iron ore is not far distant from
ner of townships 41 and 42 N., between ranges 29 and 30 W.
as found in a low ridge about three chains wide; course WNW.
idge appeared to be nearly one mass of iron ore, stratified and jointed;
uently it may be quarried with ease.
s ore has generally a granular or micaceous structure, but specular

varieties sometimes occur; color iron-black, passing into steel-gray; lustre, when fresh broken, metallic, but soon oxidises when exposed to the atmosphere.

This is supposed to be an extensive and rich bed of iron ore. The variation of the needle was taken on the east side of the ridge at the crossing of a hunter's trail, and its north end stood S. 82° E. Three or four miles west of this, on the north side of a ridge, near a cedar swamp, the variation was N. 45° 30′ W.; probably in this vicinity may be found another *extensive bed of similar* iron ore.

The second bed of magnetic iron ore was found on the east boundary of township 46 N., range 30 W., sections 1 and 6, along the southwest shore of a small lake on the Peshakumme river.

The extent of this iron ore bed is not known. It, however, borders the southwest side of the lake, from twenty to fifty feet in height. It is generally stratified and jointed, and therefore it may be quarried with ease; dip 80° SSE.; color iron-black, passing into steel-gray; lustre metallic, fresh fractures often resembling very fine-grained cast-iron. Specimens of specular iron ore were found in the lower part of the bed, near the lake. There is a good water-power on the river at the northwest end of the lake.

The third bed of magnetic iron ore was found on the east boundary of township 47 N., range 29 W., 68 chains and 50 links north on the east side of section 13, in a ledge or cliff facing the southwest, and in height from twenty to fifty feet. This ledge of ore is stratified and jointed, and dips NE. 45°; and in quality it is similar to that last above described.

The extent of this ore bed is unknown; but it was seen along the ledge for about twelve chains. At about thirteen chains to the SSW. from the section line at the ledge above named, and near the north side of a small lake, there is a knob, about thirty feet in height, of micaceous oxide of iron, and probably there is much more iron ore in this vicinity.

The fourth bed of magnetic iron ore was found near the south boundary of township 48 N., range 28 W., on section 4, sixty-two chains west on south side of section 33, and four or five chains south of line, in a knob fifty feet in height. This knob of iron ore appeared to be stratified and jointed, and much resembles a reddish brown hematite. It is, however, in some places, micaceous or granular, and associated with quartz, more or less. Lustre sub-metallic, and it slightly attracts the magnet.

The fifth bed of iron ore (magnetic) was found on the south boundary of township 48 N., range 29 W., fifty-one chains and fifty links west on south side of section 32; at forty chains, variation 17° W.; at forty-seven chains, variation 47° E.; at fifty-one chains and fifty links, ascend ridge of iron ore eight feet in height; course WNW.; at seventy-five chains, leave iron ore bed; course WNW.

This iron ore bed is very extensive, and quite variable in richness in different portions of its outcropping surface; structure granular; color iron-gray, or black; lustre in fresh fractures, metallic; highly magnetic and sometimes possessing polarity.

The sixth bed of magnetic iron ore was found on the south boundary of township 48 N., range 30 W., thirty-five chains west on south side of section 35, and one chain south of line, in a knob twenty feet in height. It appeared to be stratified and jointed, and dips ESE. 80° in the four

of veins, or interstratified with granite rocks. It is highly magnetic, and much associated with its containing rock. From the great aberrations of the needle in this vicinity, it is believed that large bodies of iron ore will be found not far distant.

The seventh bed of magnetic iron ore was found on the south boundary of township 48 N., range 30 W., fifty chains west on south side of section 34, in descending a hill; course SW. This ore has a granular structure; color dark brown. It was not seen to a great extent; but from the aberrations of the needle, and other indications, it was believed that large quantities of ore were not far distant.

The eighth bed of magnetic iron ore was found on the south boundary of township 44 N., range 31 W., eleven chains west on south side of section 33, in a ridge fifty links south of line; at twenty-nine chains, on ridge of same ore eighty feet in height; course N. and S.

This is supposed to be a very extensive body of iron ore. It is much associated with quartz, or interstratified with it. Its structure is granular and compact; color iron-gray; lustre metallic; and where most pure, it is slightly magnetic.

The ninth bed of magnetic iron ore was found on the east boundary of township 47 N., range 31 west, fifteen chains north on east side of section 25, in a hill forty feet in height; course NE. This is a micaceous oxide of iron, considerably magnetic. But little of this ore was seen on the line; the magnetic observations, however, indicate a large amount of ore not far distant.

The tenth bed of magnetic iron ore was found on the same township boundary, fifty-four chains and seventy links north on east side of section 24, in the bed and banks of a stream fifteen links wide; course NE. This stream has a fall of thirty feet over this ore.

The eleventh bed of magnetic iron ore was found on the east boundary of township 48 N., range 31 west, forty-five chains north on the east side of section 25, in the south side of a hill fifty feet in height. Dip NNE. 85°. But little ore was seen here.

The twelfth bed of magnetic iron ore was found on the east boundary of township 48 N., range 31 W., twenty-six chains north on east side of section 24, in a low ridge; course NNE. This ore is stratified, and dips NNE. 45°. It has the appearance of being extensive.

The thirteenth bed of magnetic iron ore was found on the east boundary of township 45 north, range 32 west, sixty-four chains north on east side of section 1, in a low ledge five or six feet in height; course E. and NNW. Variation 68° west.

This ore is stratified, and dips NNW. 85°. It has a dark reddish brown color and a granular structure; lustre metallic. It is not known how extensive this bed of ore is, in consequence of its being for the most part overlaid with drift.

The fourteenth bed of magnetic iron ore was found on the east boundary of township 41 north, range 29 west, twenty-five chains north on east side of section 12, in a low ridge. This ore is stratified, and dips 90°; strike east and west. Its outcrop was seen only for a short distance, but it is supposed to be an extensive bed in this ridge.

It will be useful here to state that if reference be made to the following tabular statement of minerals, and of the variation of the needle, it will be seen that at many localities where no iron ore was found, there were similar aberrations of the needle, as at and about the above mentioned ore

beds; from which it may be reasonably inferred, that at these localities the magnetic iron ore is not far distant; and probably, in many of these places it is but a few feet below the surface of the ground.

Hence it is highly probable that the recording of the aberrations of the needle at these places will result in as great a benefit to the public as the actual discoveries of iron ore on this survey.

If this should prove to be the case, another great advantage, and one not heretofore anticipated, will result from the use of the solar compass in the surveys for mines and minerals.

General remarks.

The fourteen beds of iron ore above described are the most important ores of iron, for quantity and quality, discovered within the boundaries of this survey; but other localities of these ores, in apparently less quantities, were often seen; also other varieties of iron ore, of less importance, were collected during the survey, which will be noticed in the tabular statement at the close of these remarks.

It may be reasonably inferred, that not more than one-seventh of the number of iron ore beds were seen during the survey of township lines; and if this district of townships be subdivided with care, in reference to mines and minerals, six times as many more will probably be found.

If this view of the iron region of the northern peninsula of Michigan be correct, it far excels any other portion of the United States in the abundance and good quality of its iron ores.

It is obvious, however, that, as a resource of wealth and profit to the United States, these iron ores and other minerals—also the many tracts of pine lands, and agricultural districts, together with extensive water powers—must remain comparatively useless, and these public lands must remain unsold, unless some measures be taken by the general government to open one or more communications, by rail or macadamized roads, through the iron region, from some harbor on Lake Michigan to Keweenaw bay of Lake Superior.

If such a policy be adopted, it would open a new field for enterprise and settlement, and would accomplish the further object of affording the best facilities for communication with the copper region of Lake Superior.

It would also be found of great importance in a military point of view, and as a mail route, in case of war with Great Britain.

Of the practicability of constructing such a road, it may be sufficent to state that more than one feasible locality may be had, with a good harbor at both ends, and for a macadamized road an abundance of the best materials for its construction will be found along a large portion of the line of its route, viz: greenstone and sienite, or granite.

The whole length of such a road would not probably exceed 110 miles, and it would seem that such a work could be accomplished in a profitable manner by some disposition of the public lands through which it may pass. When done, it would give the further facilities of the whole range of the great lakes, and Erie canal, &c., for obtaining the necessary supplies for working these ores, as well as for the distribution of their products; thus exhibiting the admirable wisdom and goodness of the great Creator, in the arrangement of all things for the best good of man.

Tabular statement of the specimens collected on the foregoing survey, in the year 1846.

No. of specimen.	On section	Distance. Chs.	lks.	
				West, on south boundary of township 41 *north, range* 24 *west.*
1	32	75	20	Var. 3 deg. 15 min. east. Granular lime in bed of Fort river.
2	31	36	00	Var. 20 min. west. Granular lime in bed of stream.
*3	36	48	90	Var. south 15deg. east. Granular lime in bed of small stream.
				North, on east boundary of township 41 *north, range* 27 *west.*
4	24	69	25	Granulated limestone in low ledge, course east and west.
5	36	80	00	From boulder of sulphuret of iron.
				West, on south boundary of township 41 *north, range* 27 *west.*
6	36	75	00	Granulated limestone ledge, 2 feet, course northeast and southwest.
				North, on east boundary of township 41 *north, range* 28 *west.*
7	12	28	80	Var. 5 deg. 15 min. east. Granulated limestone in north side of hill.
				North, on east boundary of township 41 *north, range* 29 *west.*
8	25	5	00	Var. 5 deg. 10 min. east. Hornblende rock, southeast side of knob, 80 feet high.
9	25	6	50	Var. 5 deg. 10 min. east. Sienitic granite, northeast side of knob, 80 feet high.
10	25	16	00	Var. 5 deg. 10 min. east. Sienitic granite, top of knob, 100 feet high.
11	25	35	50	Var. 5 deg. 25 min. east. Sienitic granite, top of ridge, course east and west.
12	25	37	00	Var. 5 deg. 25 min. east. Sienitic granite, north side of ridge.
13	25	54	00	Var. 5 deg. 25 min. east. Sienitic granite, north side of knob. 50 feet high.
14	24	57	80	Sienitic greenstone, south side of ridge, east and west, at 40 chains, var. 6 deg. 35 min. east.
15	12	25	90	Horablende slate, associated with iron, strike east and west, dip 90 deg.; at no chains, var. 13 deg. east.
16	12	52	00	Granulite, south side of foot of hill.
17	12	55	00	Hornblende rock, ascend ledge 8 feet, northeast and southwest.
18	12	74	00	Granite.
19	12	75	00	Sienitic greenstone, north side of hill.
20	12	76	00	Granite knob, 20 feet in height.
21	12	80	00	Var 10 deg. 30 min. east. Sienitic granite, traversed by large veins of quartz.
22	1	7	50	Hornblende rock, in low ledge.
23	1	8	00	Sienitic granite ledge, course east and west.
24	1	35	00	Hornblende rock in undulating land and ridges, course east and west; at 40 chains, var. 9 deg. 10 min. east.
25	1	46	00	Gneissoid granite, south side of hill, course east and west.
	1	48	00	Sienitic granite.
27	1	50	00	Gneissoid granite.
				West, on south boundary of township 41 *north, range* 29 *west.*
28	36	21	00	Sienitic granite right bank of stream, 8 links wide, course southwest; at no chains, var. 5 deg. east.
29	36	72	25	Granulite.

* Section 36, range 27 west.

Tabular statement—Continued.

No. of specimen.	On section	Distance.		
		Chs.	*lks.*	
30	35	60	00	Var. 40 deg. 20 min. east. Gneissoid granite (many low knobs of.)
31	35	23	50	Granite ledge, north side of line, 12 feet high, east and west.
32	33	40	00	Var. 40 deg. 30 min. east. Sienitic granite, with sulphuret of iron in ledge, 80 links south of line, 65 feet in height; course east and west.
33	33	60	50	Same, in ledge 20 feet high, course west-northwest.
34	33	68	25	Sienitic greenstone, with sulphuret of iron in knob.
35	32	28	50	Sienitic granite in ledge, south of line 60 feet, course west-southwest; at no chains, var. 4 deg. 50 min. east.
36	32	40	00	Var. 4 deg. 10 min. east. Micaceous hornblende slate, in knob.
37	32	60	00	Granite northwest side of hill; course southwest.
38	31	40	00	Var. 5 deg. 5 min. east. Fine-grained quartzite, 5 chains northwest top of ledge about 100 feet in height; course southwest.
39	31	49	45	Gneissoid granite, dip 40 deg. northwest; descend hill.
40	31	59	45	Brown quartzite or altered sandstone; ascend ledge of 8 feet; course southwest.
				North, on east boundary of township 41 north, range 30 west.
41	24	42	50	Sienitic greenstone, outcrop of. At 40 chains, var. 5 deg. 25 min. east
42	13	6	00	Granite, ascend ledge 8 feet; course east and west.
43	13	31	50	Sienitic greenstone, ascend ledge 20 feet; course east and west; at 40 chains, var. 5 deg. 25 min east.
44	13	66	25	Granite and pyrites of iron, ascend ledge 50 feet; course east and west.
45	12	78	50	Micaceous hornblende slate, ascend ledge 15 feet; course east and west.
	12	80	00	Var. 4 deg. 30 min. east.
46	1	1	90	Var. 4 deg. 30 min. east. Gray granite. Many similar ledges on same section.
				West, on south boundary of township 42 north, range 24 west.
47	35	15	65	Var. 5 deg. east. Limestone fossil, anthocera, from right bank of the Esconawba river.
48	33	22	00	Var. 4 deg. 45 min. east. Granulated limestone in bed of stream, 60 links north of line, course southeast.
				North, on east boundary of township 42 north, range 25 west.
49	36	64	00	Granulated limestone in bed of stream, 10 links southeast.
50	24	55	00	Var. 4 deg. east. Granulated limestone in bed of stream, 60 links east.
				West, on south boundary of township 42 north, range 25 west.
51	34	65	00	Granulated limestone. No other outcrop on this township line.
				North, on east boundary of township 42 north, range 28 west.
52	36	57	00	Sienitic granite and greenstone, 50 links west of line, in knob 14 feet in height.
53	.....	3	00	Gneissoid granite, in knob 9 feet high.

Tabular statement—Continued.

No. of specimen.	On section	Distance. Chs.	Distance. lks.	
				West, on south boundary of township 42 north, range 28 west.
54	35	10	50	Gneissoid granite and greenstone, in low knob.
	35	15	00	Same, in knob 20 feet high, in swamp.
55	35	68	00	Gneissoid granite, in knob 18 feet, 100 links south of line.
56	33	7	00	Granulite, in low ridge near surface.
57	32	29 to 75 c.		Gneissoid granite, or granulite.
				North, on east boundary of township 42 north, range 29 west.
58	36	20	00	Calciferous sandstone; mottled, and some changed by igneous action.
59	36	27	50	Same, near top of hill 200 feet high, course east and west.
60	25	29	00	Sienitic granite and greenstone, ascend ledge; course east and west.
61	24	00	25	Sienitic greenstone and hornblende, ascend ledge 12 feet; course east and west.
62	24	35	00	Sienitic greenstone, and some magnetic, south side of knob.
63	24	42	00	Compact greenstone ledge, 30 feet north side of knob.
64	13	32	00	Sienitic greenstone, with veins of quartz; knob 60 feet; at 40 chains, var. 6 deg. east.
65	13	80	00	Sienitic greenstone and pyrites of iron, 4 chains west of line.
66	13	80	00	Trappose rock, and some magnetic, 4 chains west of line.
67	13	75	00	Greenstone; some magnetic.
68	12	30	00	Talco-micaceous slate; strike east and west, dip 90 deg., in tops of ridge 30 feet high; 40 chains, var. 5 deg. east.
69	12	62	50	Granulite, porphyritic.
70	12	69	50	Var. 5 deg. 15 min. east. Gneissoid granulite.
71	1	39	00	Var. 5 deg. 10 min. east. Feldspar. Descend ledge 15 feet; east and west.
				West, on south boundary of township 42 north, range 29 west.
	35	.....		Many ledges of granite.
	34	.....		Many low ledges of granite.
				North, on east boundary of township 42 north, range 30 west.
72	36	35	00	Var. 18 deg. 30 min. east. Magnetic iron ore in north side of hill.
73	1	75 to 80 c		Argillaceous slate in spring and stream.
				West, on south boundary of township 42 north, range 30 west.
74	36	70	00	Brown quartz top of hill; course east and west.
		80	00	Variation 10 min. east.
75	35	42	20	Descend ledge or break in the hill 30 feet; a variety of rocks are found here—red and brownish quartz, compact white quartz, feldspar, micaceous hornblende slates, granulite, &c.
				West, on south boundary of township 42 north, range 31 west.
76	33	75	25	Var. 6 deg. 5 min. east; mica slates in Peshakumme river below line; dip from 45 to 60 deg. north-northwest; sections 31 and 32 underlaid with mica slates.
				North, on east boundary of township 42 north, range 32 west.
a	36	64	85	Mica slate, low outcrop of; dip north-northeast 80 deg.

Tabular statement—Continued.

No. of specimen.	On section	Distance.		
		Chs.	lks.	
b	25	5	00	Mica slate, strike north-northwest; dip 89 deg. north-northeast.
c	13	10	00	Sienitic greenstone.
				South, on east boundary of township 41 north, range 32 west.
a67	13	29	50	Mica slate top of ledge 60 feet; course northwest.
a68	13	00	00	Mica slate west of line in the falls of the Mesquacumecus river, near its junction with the Brula river.
				West, on south boundary of township 42 north, range 32 west.
a69	35	45	00	Variation 7 deg. east; mica slate in the bed of the Mesquacumecum river.
a70	35	45	00	5 chains up the stream in ledge and rapids micaceous slate; dip 75 deg north-northwest.
a71	35	54	00	Mica slate, ascend ledge 20 feet; east and west, dip 90 deg.
a72	34	56	00	Mica slate, ascend ledge 20 feet; west-southwest, dip 90 deg; at 40 chs., var. 6 deg. 15 min. east.
		65	00	Var. 35 min. east; 67 chs. 40 lks., 2 deg. 30 min. west; 68 chs. 50 lks., 5 deg. 20 min. west; 80 chs., 6 deg. 15 min. west.
	33	12	50	Var. 3 deg. 15 min. east; 17 chs. 70 lks., 7. deg. 40 min. east; 38 chs. 28 lks., 14 deg. east; 40 chs., 11 deg. 30 min. east; 80 chs., 6 deg. 30 min. east.
	32	40	00	Var. 5 deg. east.
				North, on east boundary of township 42 north, range 33 west.
a73	36	34	50	Argillaceous slate, changed by igneous action, strike southeast; dip vertical.
	36	40	00	Var. 6 deg. 30 min. east.
a74	25	69	00	Same as above.
	25	80	00	Var. 5 deg. 40 min. east.
a75	13	25	00	Same.
a76	1	28	00	Var. 9 deg. east; argillaceous slate associated with oxide of iron, strike southeast and northwest; dip 90 deg.
77	1	49	75	Argillaceous slate, changed by igneous action, strike southeast; dip 90 deg.
78	1	53	00	Sienitic greenstone.
				West, on south boundary of township 43 north, range 28 west.
79	34	80	00	Calciferous sandstone.
80	34	80	00	North of corner, 30 feet below.
81	34	80	00	North of corner 3 chs, 60 feet below first specimen—[illegible] sandrock mottled.
				North, on east boundary of township 43 north, range 29 west.
82	12	27	00	Greenstone, descend ledge 50 feet; course east and west.
83	12	53	00	Sienitic granite 100 lks. west of line.
84	12	67	00	Sienitic greenstone 100 lks. east of line.
				North, on east boundary of township 43 north, range 30 west.
85	13	45	85	Argillaceous slate, bluish red, in bed of stream, 20 lks. wide, course east; at 40 chs., var. 4 deg. 15 min. east.
86	12	9	50	Altered sandstone, bed of stream, 10 lks. wide; course southeast; also, granular quartz.

Tabular statement—Continued.

of en.	On section	Distance. Chs.	lks.	
				South boundary of township 43 north, range 30 west.
				No outcrop on this township line; deep drift; variation fluctuating.
				East boundary of township 43 north, range 31 west.
				No outcrop of rocks; high rolling land, with deep drift; var. from 3 deg. to 7 deg. 45 min. east.
				West, on south boundary of township 43 north, range 31 west.
	32	62	00	Argillaceous slates, left bank of Peshakumme river; no other outcrop.
				North, on east boundary of township 43 north, range 32 west.
	25	42	00	Compact greenstone ledge; course east and west.
	25	69	75	Var. 1 deg. 35 min. west; 72 chains 50 links, 2 deg. 55 min. west; 75 chains 50 links, 1 deg. 55 min. west; 80 chains, 2 deg. 20 min. west.
	24	73	00	Compact greenstone and pyrites of iron.
	13	10	20	Same, except iron.
	13	14	50	Var. 1 deg. 15 min. east, north side of knob.
	13	64	50	Greenstone; descend ledge, course east and west.
				West, on south boundary of township 43 north, range 32 west.
	35	12	00	Hornblende slate, strike north-northwest, dip 90 deg. 2 chs. south of line.
	31	9	50	Sienitic greenstone in knob, flanked with argillaceous slates.
	31	23	00	Argillaceous slates north point ridge, south-southwest.
	31	40	00	Var. 9 deg. 30 min. east.
				North, on east boundary of township 43 north, range 33 west.
	25	5	00	Argillaceous slates changed by igneous action and associated with oxide of iron; strike southeast, dip 90 deg.
	25	30	00	Same, strike northwest, dip 90 deg.
	25	63	00	Same. No specimen.
				West, on south boundary of township 43 north, range 33 west.
	36	28	50	Sienitic greenstone in ridge; course southeast.
	36	50	35	Argillite, much changed, irregularly stratified and jointed, strike northwest, dip 90 deg.; at 40 chains, var. 7 deg. 5 min. east.
	35	33	00	Outcrop of greenstone; var. 6 deg. 30 min. east; 40 chas., var. same.
	35	63	75	Argillite, much changed by igneous action.
	34	20	00	Argillite and pyrites of iron in drift.
	34	34	00	Do do do. Deep drift. No more outcrop to township corner.
				North, on east boundary of township 43 north, range 34 west.
	12	40	00	Hornblende slate.

Tabular statement—Continued.

No. of specimen.	On section	Distance.		
		Chs.	*lks.*	*North, on east boundary of township 43 north, range 36 west.*
103	24	40	00	Var. 6 deg. 45 min. east; sienitic greenstone, descend ledge 4 feet, east and west.
104	12	30	00	Sienitic greenstone top of ledge; southeast and northwest.
				North, on east boundary of township 44 north, range 30 west.
105	1	65	50	Gneissoid granite; var. on this township line 10 deg. east to 11 deg. west. No other outcrop of rocks.
				West, on south boundary of township 44 north, range 31 west.
106	33	11	00	Var. 4 deg. east; granular magnetic iron ore, associated with quartz, 50 links south of line, in ledge 30 feet; west-northwest
107	33	29	00	Same as last described; ledge 80 feet; course west-northwest.
	31	54	50	Compact greenstone, ascend hill and ledge 50 feet; course west-northwest.
	31	59	50	Hornblendic slate, strike east and west; dip 90 deg.
				West, on south boundary of township 44 north, range 32 west.
108	32	70	00	Sienitic greenstone.
	31	27	50	Var. 2 deg. 5 min. east; 32 chains, 30 min. east; 37 chs., 2 deg. 50 min. west; 48 chains, 1 deg. 30 min. west; 53 chains, 4 deg. east. Many low greenstone knobs on this township line.
				North, on east boundary of township 44 north, range 32 west.
	24	35	00	Outcrop of greenstone.
	24	40	00	Var. 6 deg. 15 min. east.
111	12	28	00	Sienitic granite.
	12	36	00	Var. 2 deg. 30 min. east. Sections 1 and 12 over sienitic granite.
				North, on east boundary of township 44 north, range 33 west.
112	25	11	50	Low ledge of com. greenstone west of line; course north and south.
	36	00	00	Var. 9 deg. east; 13 chains 70 links, 16 deg. east; 32 chains 38 links, 55 minutes east; 40 chains, 3 deg. 5 minutes west; 44 chains 80 links, 5 deg. 15 minutes west; 50 chains 80 links, 2 deg. 15 minutes east; 56 chains 2 deg. 10 minutes west; 76 chains 85 links, 9 deg. 40 minutes west; 80 chains, 6 deg. 40 minutes west.
	25	13	50	Var. 40 min. west; 17 chs., 50 lks., 30 min. east; 31 chs. 90 lks., 2 deg. east; 40 chs., 2 deg. 15 min. east; 80 chs., 2 deg. 40 min. east.
113	25	30	00	Outcrop of greenstone.
114	1	38	00	Greenstone ledge west point of ridge.
				West, on south boundary of township 44 north, range 33 west.
a113	32	80	00	Hornblende slate 4 chs. up the river, in left bank, strike southeast. Dip 90 deg.

Tabular statement—Continued.

No. of specimen.	On section	Distance. Chs.	lks.	
				North, on east boundary of township 44 north, range 34 west.
a114	36	20	50	Hornblende slates; ledge 12 feet west point of ridge; course southeast; dip 90 deg.; no other outcrop; deep drift.
				North, on east boundary of township 44 north, range 35 west.
115	25	43	50	Hornblendic slate in low ridge in swamp.
116	13	39	00	Hornblendic slate, ascend ledge 8 feet east and west; dip 50 deg. north-northeast.
	13	71	50	Ascend ledge 8 feet; hornblende slates; dip 50 deg. north.
				West, on south boundary of township 45 north, range 29 west.
	35	73	00	Var. 2 deg. 15 min. east; 80 chs., 11 deg. 30 min. east.
	34	11	00	Var. 5 deg. 30 min east.
	31	17	50	Var. 2 deg. 10 min. east; 30 chs., 1 deg. west; 35 chs. 50 lks., 3 deg. west; 50 chs., 3 deg. 30 min. east; no other outcrop on this township line.
				West, on south boundary of township 45 north, range 31 west.
	36	00	00	Var. 6 deg. east; 40 chs., var. 5 deg. 35 min. east.
	34	00	00	Var. 2 deg. 45 min. east; 35 chs., 1 deg. 30 min. west; 40 chs., 3 deg. 15 min. west; 51 chs., 6 deg. west; 70 chs., 11 deg. 30 min. east.
	33	00	00	Var. 13 deg. 15 min. east; 40 chs., 10 deg. 43 min. east; 55 chs., 5 deg. east.
	32	00	00	Var. 8 deg. east; 40 chs., 8 deg. east.
				North, on east boundary of township 45 north, range 32 west.
117	25	56	00	Sienitic granite east side of low knob.
118	1	64	00	Var. 68 deg. west; ledge of magnetic iron ore 5 or 6 feet in height; course east and west-northwest; dip 85 deg. north.
119	.....	.....		3 chains west of line, same; no other outcrop.
				North, on east boundary of township 45 north, range 33 west.
120	36	36	50	Greenstone trap, descend ledge 10 feet; course southeast and northwest.
		40	00	Var. 4 deg. 40 min. east.
121	25	67	50	Sienitic greenstone knob, 25 feet high.
		80	00	Var. 4 deg. 45 min. east.
				West, on south boundary of township 45 north, range 33 west.
122	36	25	00	Porphyritic greenstone, low ridge, south-southeast and north-northwest.
	36	40	00	Var. 3 deg. 15 min. east.
123	34	36	00	Porphyritic greenstone in ledge south of line, 20 feet high east and west.
	34	40	00	Var. 45 min. east.
124	34	77	00	Compact greenstone, ascend ledge 8 feet; course northwest and southeast.
	34	80	00	Var. 2 deg. 40 min. west; section 33, 10 chs., 6 deg. 25 min. west; 40 chs., 6 deg. 50 min. west; 71 chs., 70 lks., 10 deg. east; 80 chs., 13 deg. 5 min. east.
	32	40	00	Var. 7 deg. 25 min. east; 80 chs., 6 deg. 45 min. east.

Tabular statement—Continued.

No. of specimen.	On section	Distance.		
		Chs.	*lks.*	
1, 142	1	20	00	Magnetic iron ore east of line, on southwest side of small lake, in ridge 60 feet above lake. This iron is stratified. Strike nearly east and west; dip south-southeast from 70 deg. to 90 deg.
143	.....	.....		Magnetic iron ore, west of line, in right bank of Peshakumme river, near its entrance into the lake. This ore is stratified and jointed, therefore easily quarried.
	1	40	00	Var. 86 deg. west.
144	1	49	00	Reddish granite.
145	1	63	00	Sienitic granite and greenstone from knob 30 feet high.
146	1	70	00	Granulite, descend ledge 30 feet in height; course north-northeast.
				West, on south boundary of township 46 north, range 30 west.
	36	00	00	Var. 4 deg. east; gradually decreases to qr. post on section 34, where it is nothing.
	34	50	00	Var. 30 min. west.
	33	00	00	Var. 3 deg. west; 22 chains, 5 deg. west; 40 chains, 9 deg. west; 59 chains, 13 deg. 30 min. west; 66 chains 20 links, 17 deg. west.
	32	00	00	Var. 23 deg. 30 min. west; 12 chains, 33 deg. west; 18 chains 25 links, 40 deg. 30 min. west; 26 chains 50 links, 50 deg. 30 min. west; 32 chains 17 links, 59 deg. 15 min. west; 44 chains 41 links, 51 deg. west; 49 chains 23 links, 0; north end of needle dips ¼ inch, probably, over iron ore bed, mostly north of line.
	32	50	00	Var. 9 deg. east; 52 chains 40 links, 16 deg. east; 54 chs. 40 links, 40 deg. 30 min. east; 63 chains 35 links, 40 deg. 30 min. east.
	31	00	00	Var. 36 deg. east; 40 chains, 18 deg. east; 80 chains, 12 deg. east.
				North, on east boundary of township 46 north, range 31 west.
147	13	49	50	Sienitic greenstone; west side of ledge, 30 feet high.
	13	60	00	Var. 29 deg. 45 min. east.
	1	60	00	Var. 42 deg. east.
	1	81	20	Var. 32 deg. east; var. at township corner 12 deg., and increases regularly to 60 on section 1.
				South boundary of township 46 north, range 31 west.
	36	00	00	Var. 12 deg. east; gradually decreases to corner of sections 34 and 35, where it is 5 deg. 20 min. west.
	34	19	00	Var. 15 deg. 30 min. east; 34 chains, 10 deg. 45 min. east; 40 chains, 9 deg. 30 min. east; 61 chains 50 links, 7 deg. east.
	33	00	00	Var. 5 deg. 30 min. east.
	32	00	00	Var. 3 deg. east; 23 chains 50 links, 1 deg. east; 31 chs. 20 links, 4 deg. 30 min. east; 40 chains, 5 deg. east; 74 chains 90 links, 6 deg. 28 min. east.
	31	00	00	Var. 6 deg. 15 min. east; 30 chains, 4 deg. 30 min. east.
				The difference between the least and greatest variation on east boundary of township 46 north, range 32 west, is 23 deg. 40 min. Many boulders on this line.

Tabular statement—Continued.

No. of specimen.	On section	Distance. Chs.	lks.	
				The difference between the least and greatest variation south boundary of township 46 north, range 32 wes 19 deg. Many boulders.
				East boundary of township 46 north, range 33 west.
	13	25	00	Var. 7 deg. 50 min. east; 40 chains, 1 deg. 25 min. e 44 chains 50 links, 6 deg. 30 min. west; and a chains 25 links, 10 deg. 50 min. east.
	12	00	00	Var. 8 deg. 30 min. east; 40 chains, 5 deg. 50 min. e north side of lake, many greenstone boulders.
				South boundary of township 46 north, range 33 west.
	36	00	00	Var. 4 deg. 10 min. east; 40 chains, 3 deg. 5 min. eas
	35	00	00	Var. 2 deg. 20 min. east; 40 chains, 1 deg. 10 min. w 53 chains, 8 deg. 10 min. west.
	34	00	00	Var. 15 min. west; 40 chains, 25 min. west.
	33	00	00	Var. 8 deg. 20 min. east; 40 chains, 3 deg. 5 min. east
	32	00	00	Var. 6 deg. 15 min. west; 12 chains 70 links, 11 west; 40 chains, 3 deg. 10 min. east.
	31	00	00	Var. 5 deg. 33 min. west; 40 chains, 5 deg. 50 min. e
				East boundary of township 46 north, range 35 west.
	24	39	50	Greenstone ledge, 1 chain west of line, 20 feet high.
148	24	75	00	Greenstone ledge, in swamp, 2 chains east of line.
				South boundary of township 46 north, range 35 west.
149	32	6	00	Hornblende slate, in ridge; course east and west.
150	31	12	00	Do. dip north-northwest, 45 deg.
				South boundary of township 46 north, range 36 west.
	33	40	00	Var. 7 deg. 30 min. east.
151	33	52	00	Greenstone ledge, 25 links south of line.
				South boundary of township 47 north, range 27 west.
	36	00	00	Var. 5 deg. 30 min. east; 20 chains 50 links, 11 deg. e 26 chains, 16 deg. 30 min. east.
152	36	17	50	Granulite, low knob.
153	36	26	00	Slightly magnetic iron ore.
154	36	32	00	Sienitic granite, ascend ledge 20 feet; northwest and so east.
	36	40	00	Var. 5 deg. 30 min. east.
	35	00	00	Var. 5 deg. 10 min. east, 15.
155	35	15	00	Sienitic granite ledge, 25 feet north side of knob.
156	34	26	00	Granulite, descend ledge 30 feet; north and south.
157	34	40	00	Var. 3 deg. 40 min. east; sienitic granite, overl slightly magnetic iron ore.
158	34	47	70	Granite, descend ledge 16 feet; course south.
	33	00	00	Var. 3 deg. 10 min. east; 40 chains, 8 deg. east; 43 chs 11 deg. east.
159	33	46	00	Greenstone ledge, 30 feet high; course east and west.
	32	8	44	Var. 7 deg. 30 min. west.
160	32	13	50	Greenstone, in ledge 60 feet; facing the south.
161	32	40	00	Var. 5 deg. 30 min. east; feldspar ledge north side of east and west.

Tabular statement—Continued.

of ien.	On section	Distance. Chs.	lks.	
	31	00	00	Var. 5 deg. east.
	31	8	00	Green quartz ledge.
				North, on east boundary of township 47 north, range 28 west.
	36	75	00	Sienite ledge southeast side of ridge, west-southwest.
	36	80	00	Var. 5 deg. 45 min. east.
	24	40	00	Var. 8 deg. 45 min. east; numerous iron boulders east and south of quarter section corner.
	24	58	00	Red oxide of iron near top of hill, east and west.
	13	00	00	Var. 5 deg. 45 min. east; at 40 chains, 1 deg. 15 min. east; at 49 chains 50 links, 3 deg. west. Boulders of iron ore are found here.
	13	52	40	Var. 4 deg. 30 min. east.
	13	60	00	Sienitic greenstone in south side of hill.
	13	63	00	Sienite top of hill; course east and west.
				West, on south boundary of township 47 north, range 28 west.
	34	59	80	Gneissoid granite ledge north of line.
	34	59	80	Black slate from boulder in Esconawba river.
	33	52	50	Greenstone, with red oxide of iron, in ledge.
	32	18	14	Ascend ledge of greenstone; course north and south.
	31	34	00	Granite.
				West, on south boundary of township 47 north, range 29 west.
	32	13	00	Greenstone in ledge 25 feet; course southwest.
	31	34	00	Gneissoid granite.
	36	27	70	Ledge of granular quartz, east-northeast.
	36	44	00	Sienitic granite, with quartz veins; a ledge 20 feet north of line.
				North, on east boundary of township 47 north, range 29 west.
	25	29	30	Sienitic granite, ascend ledge.
	25	67	00	Sienitic granite, outcrop of.
	13	13	00	Boulders of iron ore.
	13	68	50	Magnetic iron ore, dips 45 deg. northeast; ledge 50 feet high, north-northwest.
	12	23	00	Talcose granite in point of ledge 20 feet high, west side of line.
	1	29	20	Imperfect talcose slate, ascend ledge west point of hill; course southeast.
	13	50	00	Micaceous oxide of iron in knob 5 chains west of line, north side of lake.
				East boundary of township 47 north, range 30 west.
	25	00	00	Var. 2 deg. 20 min. east.
	25	8	75	Sienitic granite, ascend ledge in knob 25 feet high.
	25	40	50	Var. 3 deg. 10 min. east; sienitic granite, ascend ledge in knob 12 feet high.
	25	53	25	Sienitic granite; knob 12 feet high.
	24	27	85	Sienitic granite, ascend knob 20 feet; 40 chains, 4 deg. 15 min. east.
	24	60	00	Sienitic greenstone; top of knob 14 feet high.
	13	00	00	Var. 5 deg. 20 min. east.
	13	18	00	Granulite; 40 chains, 5 deg. 45 min. east.

Tabular statement—Continued.

No. of specimen.	On section	Distance.		
		Chs.	lks.	
186	13	40	00	Greenstone 75 links east of line in ledge; 20 feet in knob.
187	13	35	00	Granulite in knob 30 feet high.
	12	40	00	Var. 5 deg. 30 min. east.
188	12	76	00	Granite in knob 20 feet high; 80 chains, var. 4 deg. 30 min. east.
189	1	20	50	Sienitic greenstone, ascend ledge in knob 30 feet high, east and west.
	1	40	00	Var. 6 deg. 15 min. east.
190	1	50	80	Granite, ascend ledge 20 feet; course northeast.
				West, on south boundary of township 47 north, range 30 west.
	36	00	00	Var. 8 deg. 30 min. west.
191	36	13	00	Reddish granite; top of ledge 60 feet high, northeast.
192	36	17	00	Granite, with quartz veins, descend ledge 8 feet; course southwest.
193	36	35	00	Granite in ledge, 20 feet high, 150 links north of line; course north-northeast.
	36	40	00	Var. 48 deg. west; 80 chains, 6 deg. 30 min. east.
	35	15	00	Var. 17 deg. 30 min. east.
194	35	35	00	Granite, with veins of iron ore; dip 80 deg. east-southeast.
	35	40	00	Var. 13 deg. 20 min. east; 55 chains, 11 deg. 30 min. east; 60 chains 50 links, 10 deg. 30 min. east.
195	35	77	00	Granite in ledge 30 feet high, 75 links south of line, course southwest.
196	34	25	00	Reddish granite, descend ledge 20 feet north and south.
	32	00	00	Var. 2 deg. 20 min. east; 23 chains 50 links, 30 min. east; 40 chains, 1 deg. west; 69 chains, 5 deg. 30 min. west.
	31	00	00	Var. 9 deg. west; 9 chains, 2 deg. west; 28 chains, 24 deg. west; 40 chains, 38 deg. west; 61 chains 25 links, 58 deg. east.
				North, on east boundary of township 47 north, range 31 west.
197	25	15	00	Micaceous oxide of iron in ledge top of hill, 40 feet, northeast.
	25	20	00	Var. 16 deg. east; 40 chains, 13 deg. east; 80 chains, 10 deg. 30 min. east.
198	24	54	70	Micaceous oxide of iron in bed and banks of stream, 15 links wide, falls 30 feet; course northeast; 57 chains 50 links, var. 32 deg. 30 min. west.
	13	00	00	Var. 45 min. west; 20 chains, 2 deg. 30 min. east; 26 chains, 25 deg. west; 40 chains, 1 deg. 15 min. east.
	12	00	00	Var. 9 deg. 10 min. east; 16 chains 50 links, 1 deg. east; 20 chains, 1 deg west; 40 chains, 2 deg. 15 min. west.
	1	00	00	Var. 3 deg. east; 40 chains, 30 deg. east.
				West, on south boundary of township 47 north, range 31 west.
	36	00	00	Var. 32 deg. east; 20 chains, 23 deg. east; 40 chains, 24 deg. 50 min. east; 60 chains, 16 deg. 45 min. east.
	35	00	00	Var. 13 deg. east; 40 chains, 7 deg. east.
	34	00	00	Var. 4 deg. east; 40 chains, 6 deg. 30 min. west.
	33	00	00	Var. 23 deg. east; 12 chains, 17 deg.; 21 chains, 10 deg. east; 30 chains, 5 deg. east; 40 chains, 15 deg. east; 53 chains, 9 deg. 30 min. east; 60 chains, 8 deg. east.
	32	00	00	Var. 10 deg. east; 13 chains, 9 deg. 30 min. east; 25 chains, 8 deg. 30 min. east; 40 chains, 8 deg. east.

Tabular statement—Continued.

of en.	On section	Distance. Chs.	lks.	
				North, on east boundary of township 47 north, range 33 west.
	24	39	00	Micaceous greenstone, descend ledge in knob.
	1	00	00	Var. 5 deg. 35 min. east; 40 chains, 5 deg. 20 min. east.
				West, on south boundary of township 47 north, range 33 west.
	31	35	00	Hornblende slate, descend ledge 2 feet; southwest; strike east and west; dip 90 deg.
		40	00	Var. 4 deg. 10 min. east; 80 chains, 4 deg. east.
				North, on east boundary of township 47 north, range 34 west.
	36	00	00	Var. 3 deg. 45 min. east.
	36	77	00	Hornblende slates in low ridge.
	36	80	00	Var. 5 deg. 10 min. east.
	25	34	00	Hornblende slates; strike east and west; dip 90 deg.; 40 chains, var. 6 deg. 35 min. east.
	12	40	65	Var. 6 deg. 10 min. east; greenstone north side of swamp.
	12	74	75	Greenstone in low knob.
	1	29	00	Greenstone, descend ledge 12 feet, course east and west.
				West, on south boundary of township 47 north, range 34 west.
	36	40	00	Var. 4 deg. east.
	36	50	00	Hornblende slate in low ground.
	35	00	00	Var. 2 deg. 40 min. east; 40 chains, 30 min. east.
	34	00	00	Var. 4 deg. east; 40 chains, 8 deg. east.
	33	00	00	Var. 9 deg. 55 min. east; 40 chains, 11 deg. 25 min. east.
	31	40	00	Var. 8 deg. 50 min. east.
				North, on east boundary of township 47 north, range 35 west.
	25	16	00	Hornblende slate, with red oxide of iron, south side of knob.
	25	56	75	Hornblende slate, top of low knob.
	13	38	25	Hornblende slate in stream, 5 links wide, west.
	12	33	75	Ascend ledge of hornblende slate 4 feet high.
	1	23	50	Ledge of hornblende slate, 50 links west of line; course northwest.
				West, on south boundary of township 48 north, range 27 west.
	36	79	00	Var. 5 deg. 10 min. east; greenstone in east end of ledge, south of line, 60 feet high, which extends 4 chains west.
	35	00	00	Much micaceous oxide of iron in drift.
	35	80	00	Greenstone.
				North, on east boundary of township 48 north, range 28 west.
	36	23	00	Var. 1 deg. 30 min. east.
	36	26	50	Sienitic greenstone in low knob.
	36	29	00	Hornblendic slate. Strike, east and west; dip 90 deg.
	36	32	70	Var. 7 deg. east; 37 chains, 3 deg. west; 39 chains 50 links, 25 deg. 30 min. east; 40 chains, 13 deg. east.
	36	40	00	Magnetic iron ore, associated with talc in line, 15 feet; east and west.
	36	78	50	Greenstone in ledge south side of hill, 30 feet, northeast.
	36	00	00	Var. 24 deg. 10 min. east; 40 chains 20 links, 20 deg. east; 50 chains, 25 deg. 13 min. east; 70 chains 90 links, 20 deg. east.

Tabular statement—Continued.

No. of specimen.	On section	Distance.		
		Chs.	*lks.*	
229	13	1	50	Sienitic granite, with pyrites of iron in ledge.
	13	12	00	Top of knob 25 feet high. Course northeast.
230	13	12	75	Sienitic greenstone, ascend ledge in knob 14 feet; course east and west.
	13	40	00	Var. 5 deg. east.
231	13	56	00	Sienitic granite, ascend ledge 25 feet; course east and west.
232	13	64	00	Sienitic granite, with quartz veins 4 feet wide. Descend ledge 25 feet in height.
	12	00	00	Var. 5 deg. 15 min. east.
233	12	20	00	Greenstone, associated with iron, 50 links east of line. Course north and south.
234	12	24	00	Sienitic granite, in ledge 25 lks. east of line, 75 feet high; course north and south.
235	12	30	00	Sienitic granite, in ledge 20 lks. east of line, 75 feet high; course north and south.
236	12	38	00	Sienitic granite, top of ledge, 8 feet high, southwest and northeast.
	12	40	00	Var. 4 deg. 30 min. east.
237	12	48	00	From a dike in sienitic granite, with pyrites of iron, in cliff 50 feet high; course southwest and northeast.
	1	00	00	Var. 4 deg. 30 min. east.
238	1	10	60	Granite, descend ledge 10 feet; course east and west.
239	1	14	00	Hornblende rock, with pyrites of iron, in cliff 35 feet high; course east and west.
	1	40	00	Var. 4 deg. 55 min. east.
240	1	41	00	Sienitic granite, descend ledge 50 feet, east and west.
241	1	53	36	Quartzite, ascend ledge 40 feet; course east and west.
242	1	64	50	Sienitic granite, descend ledge 40 feet, east and west.
				West, on south boundary of township 48 *north, range* 30 *west.*
243	35	59	75	Sienitic granite, top of low ledge; course northeast.
244	35	74	00	Greenstone, with pyrites of iron, top of ridge 50 feet high.
245	34	50	00	Magnetic iron ore, descend hill 30 feet; course southwest.
	34	57	00	Var. 16 deg. east; variation very fluctuating in this vicinity.
				North, on east boundary of township 48 *north, range* 31 *west.*
	25	40	00	Var. 2 deg. east.
246	25	45	00	Magnetic iron ore; dip north-northeast 85 deg.; ascend hill 50 feet.
247	24	26	00	Magnetic iron ore, stratified, in low ledge; course north-northeast.
	24	29	50	Var. 79 deg. 30 min. east; north end of needle dips ¼ inch.
	24	34	00	Var. 29 deg. east; 40 chs., var. south 72 deg. east.
	24	50	00	Var. 12 deg. east; 60 chs., var. 8 deg. east.
248	24	37	00	Sienitic greenstone, top of ledge 70 feet; course north and south.
249	24	76	00	Hornblende rock, top of hill and ledge 120 feet, east and west.
	13	00	00	Var. 6 deg. 15 min. east.
250	13	2	00	Sienitic greenstone, top of ledge 15 feet; course northeast.
251	13	8	00	Sienitic greenstone, top of ledge 10 feet; course north and south.
	13	40	00	Var. 5 deg. east.
252	13	44	00	Sienitic greenstone, top of ledge 12 feet; course north and south.
253	13	76	00	Sienitic greenstone, ascend ledge 25 feet, northeast.
	13	80	00	Var. 6 deg. 30 min. east.

Tabular statement—Continued.

No. of specimen.	On section	Distance. Chs.	lks.	
	1	00	00	Var. 5 deg. 15 min. east.
254	1	21	58	Sienitic granite, ascend ledge 15 feet; course northeast.
	1	40	00	Var. 5 deg. 15 min. east.
255	1	45	65	Sienitic granite, ascend ledge 25 feet; course east and west.
256	1	78	00	Sienitic granite, ascend ledge 30 feet; course east and west.
	1	80	00	Variation 5 deg. east.
				West, on south boundary of township 48 north, range 31 west.
	36	40	00	Var. 4 deg. 30 min. east.
257	36	73	00	Sienitic greenstone, from perpendicular ledge south of line; course east and west.
	35	00	00	Var. 5 deg. 30 min. east.
258	35	42	00	Greenstone, descend ledge 8 feet, east and west.
				North, on east boundary of township 48 north, range 32 west.
262	24	18	00	Quartz, associated with iron ore from boulder.
263	13	47	00	Micaceous hornblende slate, outcrop of.
	12	29	00	Hornblende slate; dip 90 deg.
264	12	59	50	Ascend hill of granite; course east and west.
	12	79	00	Top of hill.
				West, on south boundary of township 48 north, range 32 west.
265	33	69	00	Outcrop of micaceous hornblende slate.
266	32	3	00	Outcrop of micaceous ledge, 4 feet; course east and west; dip 85 deg. south.
				North, on east boundary of township 48 north, range 33 west.
	24	00	00	Var. 7 deg. 10 min. east; 40 chains, 7 deg. 40 min. east.
	13	00	00	Var. 8 deg. 20 min. east; 21 chains, 9 deg. 45 min. east; 40 chains, 7 deg. 15 min. east; 48 chains 50 links, 9 deg. 40 min. east.
	12	00	00	Var. 7 deg. 45 min. east.
267	12	3	75	Hornblende slate in southwest side of hill.
	12	40	00	Var. 8 deg. 10 min. east; 80 chains, 7 deg. 35 min. east.
				West, on south boundary of township 48 north, range 33 west.
268	34	31	00	Var. 6 deg. 15 min. east; greenstone in low ridge, 150 lks. north of line; course east and west.
a268	32	15	00	Greenstone in low knob.
	32	40	00	Var. 5 deg. 40 min. east.
				North, on east boundary of township 48 north, range 34 west.
	36	00	00	Var. 5 deg. 40 min. east; 40 chains, 6 deg. 10 min. east; 80 chains, 6 deg. 15 min. east.
	24	00	00	Var. 6 deg. 30 min. east.
O	24	59	00	Hornblende slate.
P	1	37	65	Sienitic greenstone, descend ledge; course northwest.
				West, on south boundary of township 48 north, range 34 west.
I	36	40	00	Var. 5 deg. 25 min. east; sienitic greenstone in ledge 10 feet, 50 links south of line; course east and west.
K	34	9	00	Greenstone top of ridge, in ledge 30 feet.

Tabular statement—Continued.

No. of specimen.	On section	Distance. Chs.	Distance. lks.	
L	34	17	00	Sienitic greenstone top of knob 20 feet.
M	34	24	50	Do in knob 15 feet.
	34	40	00	Var. 7 deg 45 min. east.
N	33	15	50	Greenstone, ascend ledge 20 feet northwest.
	32	00	00	Var. 7 deg. 45 min. east; 40 chains, 7 deg. 30 min. east; 80 chains, 8 deg. east.
				North, on east boundary of township 48 north, range 35 west.
	25	8	00	Outcrop of hornblende slate.
269	13	9	00	Sienitic greenstone, ascend ledge 8 feet; course west.
	13	11	50	Sienitic greenstone, descend ledge 30 feet; course west.
270	13	41	80	From calcareous boulder in stream.
	12	68	64	Red clay, right bank of stream 3 links wide; course south-east.
271	1	23	40	Greenstone in ledge 10 feet, 50 links west of line.
				West, on south boundary of township 49 north, range 27 west.
272	36	10	00	Veinstone in ledge of greenstone in bank of ravine south of line.
	36	40	00	Var. 5 deg. 30 min. east.
273	36	45	00	Greenstone, descend ledge 12 feet; course north and south.
	35	30	00	Var. 18 deg. east.
274	35	32	00	Talcose slate or felsite, ascend ledge 20 feet; course north-east.
	35	40	00	Var. 8 deg. 10 min. east.
275	35	64	50	Talcose slate, dip south-southwest 75 deg.; 80 chains, var. 5 deg. east.
276	34	55	00	Argillaceous slate, dip south-southwest 60 deg., in right bank of stream.
	32	50	00	Argillaceous slates and boulders in drift.
				North, on east boundary of township 49 north, range 28 west.
277	25	67	00	Var. 5 deg. 30 min. east; imperfect talcose slates or felsite, with veins of quartz and red oxide of iron; dip 80 deg. south-southwest.
278	24	5	00	Imperfect talcose slates, descend hill west-northwest.
	24	12	00	Low knob of compact greenstone.
279	24	23	75	Sienitic greenstone, ascend hill east and west.
	24	40	00	Var. 6 deg. 35 min. east.
280	24	46	00	Sienitic greenstone.
	12	40	00	Var. 5 deg. 10 min. east.
281	12	47	00	Talco-hornblendic slate, ascend hill 400 feet above the valley; ledge 40 feet; course southeast; estimated height 1,200 feet above Lake Superior.
282	1	7	00	Hornblendic slate; dip 85 deg. north-northeast; descend ledge west-northwest; in 20 chains from top of hill, probable descent 400 feet.
				West, on south boundary of township 49 north, range 28 west.
283	33	14	00	Compact hornblende slates, outcrop of.
284	33	33	00	Do do do.
285	.....	.....		Compact hornblende in ridge; course east and west.

Tabular statement—Continued.

No. of specimen.	On section	Distance.		
		Chs.	*lks.*	*North, on east boundary of township 49 north, range 29 w*
286	36	46	50	Sienitic granite, descend ledge 20 feet; course east and v
287	36	58	00	Sienitic granite, ascend ledge 20 feet; course east and v
288	25	35	70	Sienitic granite, ascend ledge; course east and west.
	1	22	60	Sienitic granite, foot of ledge 150 feet, east and west.
				North, on east boundary of township 49 north, range 30 w
289	36	80	00	Var. 5 deg. 15 min. east. Sienitic granite top of ledg feet east and west.
290	25	21	00	Sienitic granite, descend ledge 50 feet; course east west.
	25	40	00	Var. 5 deg. 15 min. east.
291	25	53	50	Sienitic granite, descend ledge 40 feet; course east west.
	24	00	00	Var. 2 deg. east.
292	24	5	50	Sienite, descend ledge 35 feet; course east and west.
293	24	11	00	Sienitic granite, top of ledge 35 feet, east and west.
	24	40	00	Var. 6 deg. 15 min. east.
294	24	68	00	Sienitic granite, top of ledge 18 feet; course east and v
295	24	79	00	Greenstone, ascend ledge 30 feet; course east and wes
	13	00	00	Var 2 deg. 45 min. east.
296	13	13	50	Sienitic granite, ascend ledge 35 feet; course east and v
	13	40	00	Var. 4 deg. 30 min. east.
297	13	69	00	Sienitic greenstone, top of ledge, 15 feet, east and west
298	12	4	50	Sienitic granite, ascend ledge 15 feet, east and west.
299	12	8	50	Sienitic granite, with pyrites of iron.
300	12	25	50	Sienitic greenstone, top of ledge 15 feet.
301	12	41	75	Sienitic granite, top of ledge in knob, 14 feet.
302	12	48	50	From ledge with much quartz, top of knob 16 feet.
303	12	56	00	Sienitic granite in knob and ledge, 18 feet.
	1	00	00	Var. 5 deg. east.
304	1	8	00	Sienitic granite, top of ledge 18 feet.
305	1	18	00	Sienitic granite, top of ledge 35 feet.
306	1	33	50	Sienitic granite, with much quartz, in ledge 30 feet.
307	1	55	00	Sienitic granite, ascend ledge 40 feet.
				West, on south boundary of township 49 north, range 29 w
308	36	47	00	Sienitic granite in ledge 1 ch. south of line east and we
309	35	49	75	Quartz and iron ore from large vein in sienitic granite.
310	34	25	00	Green quartz, ascend ledge; course northwest.
311	34	32	00	Sienitic granite, ascend hill and ledge 40 feet; course so west.
312	34	50	00	Sienitic greenstone, low ledge, 1 chain south of line.
313	34	60	50	Sienitic greenstone, ascend ledge 25 feet, north and sou
314	33	24	00	Sienite in ledge 25 feet high; 40 chs., var. 6 deg. 15 east.
315	33	30	00	Granulite ledge, 20 feet in height.
316	33	46	25	Sienite, descend ledge 25 feet; course north and south
317	33	69	00	Sienite in low ledge, 1 chain south of line.
318	33	72	50	Greenstone, descend ledge 25 feet; course north and so
319	32	29	00	Sienitic granite, ascend ledge 25 feet; course north south.
320	32	51	50	Sienitic granite in ledge north of line, 40 feet, east and v
321	32	63	50	Sienitic granite, descend ledge 25 feet, north and south
	32	80	00	Var. 5 deg. east.
322	31	63	50	Sienite in ledge 40 feet north of line.
323	31	68	00	Greenstone, with pyrites of iron.

Tabular statement—Continued.

No. of specimen.	On section	Distance.		
		Chs.	lks.	*West, on south boundary of township 49 north, range 30 west.*
	36	00	00	Var. 4 deg. 30 min. east; 40 chs., 4 deg. 50 min. east.
324	36	56	60	Sienitic granite, ascend ledge 30 feet; course north and south.
325	36	68	50	Sienitic greenstone, descend ledge 40 feet; course north and south.
326	36	75	00	Sienitic greenstone, descend ledge 80 feet, north and south.
327	35	8	25	Sienitic granite in ledge 25 feet, north and south.
328	35	31	00	Felspar in ledge 70 feet north of line, northeast.
329	34	00	75	Var. 5 deg. 10 min. east; sienitic granite, descend ledge 25 feet, north and south.
330	34	17	60	Sienitic granite, descend ledge 30 feet, north and south.
331	34	41	00	Sienitic granite, top of ledge 35 feet; course northeast.
332	34	45	00	Sienitic greenstone, descend ledge 40 feet, northeast.
333	34	69	00	Sienitic greenstone top of ledge 35 feet, northwest.
334	33	21	00	Sienite, ascend ledge 30 feet; course northeast.
335	33	38	00	Hornblende, descend ledge 25 feet; course southwest.
336	33	57	50	Sienite, ascend ledge 35 feet; course southwest.
	32	00	00	Var. 4 deg. 50 min. east.
337	32	5	00	Sienite top of ledge 30 feet.
338	32	8	80	Sienite, descend ledge 30 feet; course north and south.
339	32	70	00	Sienite, descend ledge 30 feet, north and south.
	31	00	00	Var. 5 deg. east.
340	31	6	00	Sienite, descend ledge 25 feet; course north and south.
341	31	10	00	From dike in greenstone; ascend ledge, south.
342	31	28	15	Sienite, descend ledge 10 feet; course north and south.
343	31	46	00	Sienite, ascend ledge 25 feet; course north and south.
344	31	56	00	Sienite, descend ledge 14 feet; course north and south.
345	31	68	00	Sienite, descend ledge 25 feet; course north and south.
				North, on east boundary of township 49 north, range 31 west.
346	36	23	50	Sienite, ascend ledge in ridge 25 feet; course east and west.
	36	40	00	Var. 5 deg. 45 min. east.
347	36	78	21	Sienite, descend ledge 10 feet, east and west; 80 chains, var. 5 deg. east.
348	25	40	30	Sienite, ascend ledge 10 feet; indications of iron ore in veins; var. 6 deg. 45 min. east.
349	25	47	50	Sienite, ledge 18 feet; course east and west.
	24	00	00	Var. 5 deg. 20 min. east.
350	24	18	00	Sienite in ledge 30 feet; course northwest.
351	13	44	00	Sienite, top of ledge 25 feet; course east and west.
352	13	70	00	Sienite, descend ledge 40 feet; course east and west.
353	12	33	50	Sienite, descend ledge 30 feet; course east and west; var. 5 deg. east.
				West, on south boundary of township 49 north, range 31 west.
	35	40	00	Var. 5 deg. 50 min. east.
354	35	48	16	Talcose granite, top of ledge 18 feet; course northwest.
355	35	66	00	Sienitic granite, top of ledge 15 feet; course northeast.
356	35	71	00	Sienitic granite, top of ledge 20 feet; course northeast.
	35	80	00	Var. 6 deg. 45 min. east.
357	32	40	80	Var. 6 deg. east; sienitic granite, descend ledge 18 feet; course northeast.
				North, on east boundary of township 49 north, range 32 west.
358	36	41	50	Sienitic granite, outcrop of.
	24	20	50	Knob of sienitic granite.

Tabular statement—Continued.

No. of specimen.	On section	Distance.	
		Chs. *lks.*	
359	24	37 00	Sienitic granite from ledge in knob; course east and w
360	13	15 00	Granite west of line, on point between lakes.
	13	36 88	Many granite knobs north side of lake.
361	1	7 00	To 44 chains, sienitic granite.
			West, on south boundary of township 49 north, range 32
362	36	26 50	Greenstone in ledge; course north and south.
363	34	15 00	Gneissoid granite in ledge 3 chains north of line, eas west.
364	34	43 00	Gneissoid granite, ascend ledge 30 feet, west-southwe
365	33	67 00	Greenstone, descend ledge, course southeast and north
366	33	77 00	Sienitic granite, descend 10 feet; course northwest.
367	32	23 00	Hornblende slate in knob 10 feet high.
368	31	1 00	Hornblende slate north side of hill.
			West, on south boundary of township 49 north, range 33
369	31	12 55	Hornblende slate in falls 18 feet in stream.*
			North, on east boundary of township 49 north, range 23
370	25	11 00	Var. 7 deg. 15 min. east; sienitic granite, with vei quartz.
371	25	27 80	Sienitic granite, ascend ledge 15 feet; course southwe
	25	40 00	Var. 6 deg. 15 min. east.
372	24	49 25	Sienitic greenstone, ascend ledge 15 feet.
373	24	59 92	Sienitic granite, ascend ledge 40 feet, east and west.
374	24	62 55	Sienitic greenstone, descend ledge 60 feet, northeast.
	13	00 00	Var. 7 deg. 20 min. east.
375	13	25 00	Sienitic granite in east end of hill.
376	13	79 50	Sienitic granite in knob 20 feet in height.
	12	00 00	Var. 6 deg. 10 min. east.
377	12	23 70	Greenstone, descend ledge 16 feet; course east and w
378	12	50 50	Sienitic greenstone in ledge, northwest side of hill.
	1	40 00	Var. 5 deg. 55 min. east.
379	1	47 00	Hornblendic rock, descend ledge 15 feet, east and we
			West, on south boundary of township 49 north, range 33
	34	00 00	Var. 6 deg. 55 min. east.
380	34	16 00	Compact greenstone, descend ledge 14 feet, northeast.
			North, on east boundary of township 49 north, range 36
382	1	5 00	Var. 5 deg. 20 min. east; greenstone, base of kn lks. west of line.
383	1	9 04	Var. 6 deg. 30 min. east; compact greenstone trap, c feet.
384	1	12 00	Greenstone trap, with gray sulphuret of copper, northwest in dig.
384, 385	1	12 00	Calcareous spar, from vein near house on east side o (called Silver mountain.)
386	1	12 00	Trap and steatite, from vein north of house on east mountain.
387	1	43 75	Greenstone trap, north side of mountain.

Tabular statement—Continued.

No. of specimen.	On section	Distance.		
		Chs.	*lks.*	*West, on south boundary of township 50 north, range 27 west.*
	35	00	00	Var. 5 deg. 35 min. east.
388	35	4	55	Sienitic granite, with veins of greenstone, top of knob.
	35	40	00	Var. 3 deg. 20 min. east; at 45 chs., 8 deg. east.
389	35	46	00	Greenstone, foot of ledge 40 feet high, northeast.
390	35	52	00	Sienite, descend ledge 35 feet, north and south.
391	33	39	75	Var. 5 deg. east; compact greenstone, ledge 5 feet, 30 lks. south of line, east and west.
392	33	57	00	Sienitic greenstone, descend ledge 40 feet; course northeast and southwest.
	31	45	70	Greenstone, descend ledge and hill.
				North, on east boundary of township 50 north, range 28 west.
	36	75	00	Var. 12 deg. east.
393	36	79	50	Greenstone, ascend ledge 15 feet; course east and west; at 80 chs., var. 8 deg. east.
394	25	2	00	Greenstone, in ledge 20 feet; course east-northeast.
	25	40	00	Var. 5 deg. 25 min. east.
395	24	1	50	Granulite and greenstone, ascend ledge; course east and west.
396	13	62	50	Sienitic granite, foot of ledge 150 feet high, east and west.
397	12	13	50	Sienitic granite, top of ledge 100 feet high, east-northeast.
398	12	28	00	Sienitic granite, bottom of ravine; course east-northeast.
399	12	34	00	Sienitic granite, with quartz veins, top of ledge 80 feet; course east and west.
400	1	10	00	Sienitic granite, east side of ridge, north and south-
				West, on south boundary of township 50 north, range 28 west.
	36	5	80	Descend ledge 30 feet; course west-northwest.
	35	12	50	Ascend ledge 25 feet; course north and south.
	34	73	00	West side of hill and ledge.
	32	59	00	Descend hill and ledge; course north and south.
	32	60	20	A stream; course north.
	31	5	00	Top of granite knob.
	31	78	50	Descend ledge 50 feet; course northwest; rocks on this township line are mostly sienitic granite and greenstone.
				North, on east boundary of township 50 north, range 29 west.
	25	00	00	Var. 5 deg east.
401	25	37	00	Sienitic granite, in ledge 1 ch. east of line; course north and south.
	25	41	50	Sienitic granite, 20 lks. west of line, in ledge 20 feet, south-southwest.
	25	45	00	Sienitic granite ridge; course northwest.
	25	67	82	Sienitic granite, in knob.
402	25	70	00	Greenstone, descend ledge 60 feet; course northwest.
	24	00	00	Var. 5 deg. 15 min. east.
	24	26	00	Sienitic granite, descend ledge 40 feet, east and west.
403	24	33	00	Sienitic granite, with veins of quartz, descend ledge 60 feet, east and west.
	12	00	00	Var. 4 deg. 50 min. east.
				West, on south boundary of township 50 north, range 29 west.
	36	00	00	Var. 5 deg. 15 min. east.
	36	2	00	Sienitic granite.
	34	78	70	Sienitic granite, descend ledge; course north and south.
	34	78	70	Many knobs, north and south of line, in swamp.

Tabular statement—Continued.

No. of specimen.	On section	Distance.		
		Chs.	*lks.*	
	33	17	50	Sienitic granite, foot of knob.
	33	40	00	Var. 15 deg. 30 min. east; sienitic gr swamp.
	32	00	70	Sienitic granite, descend ledge, north a
	32	2	50	Do. ascend ledge 25 ft.; cou
	32	52	00	Do. ascend ledge 20 feet;
	31	40	00	Var. 5 deg. 15 min. east.
	31	56	50	Sienitic granite, ascend cliff 35 feet; east.
				North, on east boundary of township 50 n
404	36	27	00	Sienite, top of ledge 70 feet; course so
	36	40	00	Var. 5 deg. 15 min. east.
405	36	43	00	Sienite, top of ledge 20 feet; course s
406	36	47	00	Do. do. 30 feet; course e
407	36	62	00	Do. do. 18 feet; course e
	25	40	00	Var. 4 deg. east.
408	25	53	90	Sienite, ledge 20 feet high.
409	13	53	00	Var. 5 deg. 20 min. east; Hornblend feet.
				West, on south boundary of township 50
410	36	8	50	Sienite, top of ledge 30 feet; course so
411	36	28	00	Do. do. 35 feet.
	36	40	00	Var. 5 deg east.
412	36	68	00	Sienite, ascend ledge 35 feet; course so
413	36	73	80	Do. descend ledge 40 feet; course
414	35	23	00	Do. ascend ledge 15 feet; course s
415	35	37	00	Do. top of ledge 50 feet; course no
416	35	47	50	Do. top of ledge 35 feet; course no
417	34	12	00	Do. top of ledge 50 feet, south of li
418	34	15	80	Do. ascend cliff 20 feet; course nor
419	34	21	50	Do. top of hill and ledge 75 feet;
420	34	29	00	Do. descend ledge 50 feet; course
421	34	46	00	Reddish granulite, descend hill 40 feet,
422	34	70	75	Do. top of ledge 75 feet,
423	33	44	00	Do. do. 50 feet,
424	33	63	00	Do. do. 60 feet,
425	32	55	00	Do. do. 40 feet,
	31	00	00	Var. 5 deg. 30 min. east.
426	31	14	00	Sienitic greenstone, top of ledge 48 southwest.
				North, on east boundary of township 50 n
	36	00	00	Var. 5 deg. 30 min. east.
427	36	24	00	Sienite, ascend ledge 40 feet; northwe
428	25	62	00	Do. top of ledge 40 feet; east and
429	24	1	40	Do. ascend ledge 45 feet; east and
430	24	36	00	Sienitic greenstone, ascend ledge 30 fe
431	24	72	50	Do. top of ledge 30 fe
	13	00	00	Var. 5 deg. east.
432	13	7	40	Sienite, ascend ledge 30 feet; course so
433	12	14	50	Do. top of ledge 20 feet; course ea

Tabular statement—Continued.

No. of specimen.	On section	Distance.	
		Chs. lks.	*West, on south boundary of township 50 north, range 31 west.*
434	35	65 00	Granite, ascend ledge 18 feet; course north and south.
435	33	33 00	Sienitic granite, top of ledge 30 feet; course southwest.
436	33	78 00	Do. ascend ledge; course northwest.
	32	00 00	Var. 5 deg. 30 min east.
437	32	21 00	Greenstone, ascend ledge 15 feet; course north and south.
438	32	28 00	Granite, top of ledge 20 feet; course north and south.
439	32	37 00	Do. do. 30 feet; course northeast.
440	32	68 00	Do. do. 16 feet; course north and south.
			North, on east boundary of township 50 north, range 32 west.
441	25	7 00	Hornblende rock, descend ledge; course northwest.
442	1	15 15	Sienitic granite, ascend ledge and hill.
	1	32 00	Quartzite, descend ledge and hill; course east and west.
443	1	42 00	Granular quartz in ledge; course north and south.
			West, on south boundary of township 50 north, range 32 west.
	36	25 00	Granite in low ledge.
444	36	46 00	Quartzite, descend ledge 15 feet; course north and south.
445	33	24 00	Sienite, descend ledge 5 feet; course north and south.
446	32	15 00	Sienitic greenstone, top of knob.
447	32	38 00	Sienitic greenstone, with quartz veins. Ascend ledge 15 feet; course north and south.
			North, on east boundary of township 50 north, range 33 west.
448	36	63 00	Greenstone, descend hill; course east and west.
449	36	70 00	Hornblende slate, in ravine; course north.
450	24	42 00	Greenstone, outcrop of, 80 links west of line.
			West, on south boundary of township 50 north, range 33 west.
	13	00 00	Var. 5 deg. 45 min. east.
451	13	13 00	Outcrop of hornblende slate; 40 chains, var. 6 deg. 15 min. east.
452	13	17 00	Hornblende slates, ascend ledge 30 feet; course north and south; dip 45 deg. south-southwest.
			North, on east boundary of township 50 north, range 34 west.
	24	60 00	On trail, hornblende slates.
	13	20 00	In ravine, loose pieces of hornblende slates.
453	.....	.....	Argillaceous and hornblendic slates, south end of Keweenaw bay, in stream near Childe's and Brushe's mills.

WM. A. BURT, *Deputy Surveyor.*

DETROIT, *March* 20, 1847.

Catalogue of plants collected by William A. Burt, esq., on the primit region south of Lake Superior, in 1846; *by Dennis Cooley, of Washin ton, Michigan.*

The following catalogue of plants was collected during the progress the survey of township lines south of Lake Superior, between latitu 45° 53′ and 46° 45′ north.

It is not pretended that this catalogue is complete, but that it embra such plants as may be found in many parts of the survey, and in most them in nearly every township.

These specimens of plants were referred to Dr. Dennis Cooley, wh long experience in the science of botany is a sufficient guarantee for th correct classification, &c.

WILLIAM A. BURT,
Deputy Surveyor.

EXOGENOUS PLANTS.

Ranunculaceæ.

Clematis Virginiana, L.; township 46 north, range 29 west.
Anemone Pennsylvanica, L.; township 41 north, range 26 west.
nemorosa, L.; township 42 north, range 26 west.
Virginiana, L.; township 43 north, range 30 west.
Hepatica Americana, D. C.; township 41 north, range 26 west.
Ranunculus flammula, L.
Caltha palustris, W.; township 42 north, range 26 west.
Coptis trifolia, Sairs; township 41 north, range 26 west.
Aquilegia Canadensis, L.; township 45 north, range 28 west.
Actea rubra, W.; township 42 north, range 24 west.
alba, Big.; township 48 north, range 35 west.
Cimicifuga racemosa, Ell.; township 45 north, range 35 west.
Thalictrum cornuti, L.; township 43 north, range 33 west.

Berberidaceæ.

Leantice thalietroides, L.; township 42 north, range 24 west.

Nymphæaceæ.

Nuphar advena, Ait.
Nymphœa odorata, Ait.

Saraceniaceæ.

Saracenia purpurea, L.; township 42 north, range 31 west.

Papaveraceæ.

Sanguinaria Canadensis, L.; township 42 north, range 24 west.

Fumariaceæ.

Corydalis glauca, Ph.; township 50 north, range 36 west.

Cruciferæ.

Cardamina hirsuta, L.; township 42 north, range 26 west.

Polygalaceæ.

gala paucifolia, Willd.; township 41 north, range 24 west.

Violaceæ.

ı blanda, Willd.; township 42 north, range 24 west.
Muhlenbergii, Tor.; township 42 north, range 29 west.
Canadensis, L.; township 42 north, range 24 west.

Hypericaceæ.

ericum corymbosum, W.

Balsaminaceæ.

atiens fulva, Nutt.; township 43 north, range 28 west.

Oxalidaceæ.

lis stricta, L.; township 43 north, range 27 west.

Aceraceæ.

r rubrum, L.
saccharinum, L.; township 42 north, range 30 west.
nigrum, Mx.
striatum, Mx.; township 49 north, range 32 west.
spicatum, Lam.

Celastraceæ.

hylea trifoliata, L.; township 43 north, range 28 west.

Rhamnaceæ.

ıothus Americanus, L.; township 50 north, range 32 west.

Rosaceæ.

ns Americanus, Marshall; township 42 north, range 31 west.
ous Virginiana, L.
serotina, D. C.; township 43 north, range 28 west.
depressa, Ph.
Pennsylvanica, A.
ea salicifolia, L.; township 50 north, range 36 west.
ı rivale, L.; township 45 north, range 28 west.
steina fragarioides, Mx.; township 43 north, range 29 west.
ıtilla simplex, Mx.; township 42 north, range 2 west.
rum palustre, L.; townships 41 and 42 north, ranges 24 and 25 west.
ria Virginica, L.; township 41 north, range 26 west.
s odoratus, L.; township 43 north, range 28 west.
strigosus, Mx.; township 42 north, range 31 west.
Canadensis, L.; township 43 north, range 30 west.
trivialis, Mx.; township 43 north, range 30 west.
Carolina, L.; township 45 north, range 28 west.
parviflora, W.; township 43 north, range 28 west.

Cratægus coccinea, L.; township 45 north, range 35 west.
Pyrus Americana, D. C.; township 43 north, range 30 west.
coronaria, L.; townships 42 and 43 north, ranges 26 and 27 west.
arbutifolia, L.
var. melanocarpa; townships 42 and 43 north, ranges 26 and 27 west.
Amelanchiler Canadensis, T. and G.
var. votryapium, T. and G.; township 42 north, range 30 west.

Onograceæ.

Epilobium spicatum, L. R.; township 45 north, range 28 west.

Grossulaceæ.

Ribes laonstris, Poir.; township 42 north, range 24 west.
floridum, L'Her.; township 42 north, range 30 west.
rubrum, L.; township 43 north, range 33 west.
albinervium, Mx.; township 43 north, range 33 w.

Saxifraajaceæ.

Mitella nuda, L.; township 43 north, range 31 west.

Umbelliferæ.

Sanicula Marylandica, L.; township 42 north, range 31 west.

Araliaceæ.

Aralia nudicaulis, L.; township 42 north, range 24 west.
racemosa, L.; township 43 north, range 25 west.
Panax quinquefolia, L.; township 43 north, range 34 west.

Cornaceæ.

Cornus stolonifera, Mx.; township 42 north, range 30 west.
Canadensis, L.; township 41 north, range 26 west.
florida, L.

Caprifoliaceæ.

Lanicera parveflora, Lam.; township 41 north, range 26 west.
ciliata, Muhl.; township 45 north, range 28 west.
oblongifolia, Hook.; township 43 north, range 30 west.
Linnæa borealis, Gron.
Diervilla trifida, Moench; township 45 north, range 28 west.
Sambucus pubens, Mx.; township 46 north, range 33 west.
Viburnum lentago, L.; township 48 north, range 35 west.
opulus, L.; township 44 north, range 32 west.
acerifolium, L.; township 43 north, range 28 west.

Rubiaceæ.

Galium aparine, L.; township 41 north, range 26 west.
asprellum, Mx.; township 42 north, range 26 west.
obtusum, B. W.; township 42 north, range 26 west.
Mitchella repens, L.; township 43 north, range 27 west.

Valerianaceæ.

Valeriana sylvatica, Herb., Banks.
var. uliginosa, T. and G.

Compositæ.

Aster punicens, L.; township 46 north, range 29 west.
macrophyllus, L.; township 42 north, range 24 west.
Solidago latifolia, L.; township 43 north, range 30 west.
neglecta, T. and G.; township 47 north, range 29 west.
Achillea millefolia, L.; township 41 north, range 25 west.
Antennaria dioica, Goirtu; township 41 north, range 25 west.
Cirsium muticum, Mx.; township 42 north, range 26 west.
Tabulus albus, Hook.; township 42 north, range 24 west.

Campanulaceæ.

Campanula rotundifolia, W.; township 42 north, range 29 west.

Ericaceæ.

Andromea polifolia, Mx.; township 45 north, range 28 west,
calyculata, W.; townships 42 and 43 north, ranges 26 and 27 west.
Arctostaphylus uva-ursi, L.; township 50 north, range 36 west.
Gaultheria procumbens, L.; township 42 north, range 27 west.
hispidula, M.; township 41 north, range 26 west.
Kalmia glauca, A.; township 41 north, range 28 west.
Epigea repens, L.; township 42 north, range 24 west.
Ledum latifolium, A.; township 43 north, range 29 west.
Vaccinium resendrum, L.; township 49 north, range 30 west.
corymbosum, L.; township 42 north, range 32 west.
Pennsylvanicum, Mx.; township 49 north, range 35 west.
Oxycoccus macrocarpus, P.; township 41 north, range 26 west.
Pyrola secunda, L.; township 41 north, range 24 west.
chlorantha, Swartz.; township 43 north, range 28 west.
uniflora, L.; township 45 north, range 28 west.
Chimaphila umbellata, W.; township 41 north, range 26 west.

Aquifoliaceæ.

Nemopanthes Canadensis, L.; township 50 north, range 32 west.
Prinos vertieillatus, L.; township 49 north, range 31 west.

Primulacæ.

Trientalis Americana, Ph.; township 41 north, range 25 west.

Lentibulacea.

Utricularia cornuta, Mx.; township 42 north, range 31 west.

Scrophulariaceæ.

Pedicularis Canadensis, L.; township 42 north, range 25 west.

Labiatæ.

Mentha borealis, Mx.; township 45 north, range 35 west.
Prunella vulgaris, L.; township 42 north, range 25 west.

Conoolonlaceæ.

Calystegia spithamæus, L.; township 45 north, range 28 west.

Gentianaceæ.

Gentiana saponaria, L.; township 42 north, range 24 west.
Menyanthes trifoliata, L.; township 42 north, range 28 west.

Oleaceæ.

Fraxinus sambucifolia, Lam.
acuminata, Lam.
quadrangulata, W.

Aristochiaceæ.

Asarum Canadense, L.; township 43 north, range 33 west.

Phymelaceæ.

Direa palustris, L.; township 43 north, range 31 west.

Ulmaceæ.

Ulmus racemosa, Thomas.

Capulifera.

Quercus alba, L.; township 41 north, range 30 west.
bicolor, Willa.; township 50 north, range 32 west.
coccinea, Wang.; township 42 north, range 24 west.
Fajus ferruginea, Ait.
Corylus rostrata, Ait.
Carpinus Americana, W.; township 42 north, range 30 west.

Betulaceæ.

Betula papyracea, Ait.
populifolia, Ait.
excelsa, Ait.
glandulosa, Willa.
Alnus serratula, Willa.

Myricaceæ.

Comptonia asplenifolia, Ait.; township 41 north, range 29 west.

Salicaceæ.

Salix Mulenburgiana, Willa; township 45 north, range 28 west.
Populus tremuloides, Mx.
balsamifera, W.

Urticaceæ.

Humulus Lupulus, L.; township 42 north, range 25 west.

Coniferæ.

Pinus resinosa, Lamb; township 50 north, range 36 west.
banksiana, Lamb; township 49 north, range 35 west.
strobus, L.; township 42 north, range 30 west.

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ius Americana, Mx.; townships 42 and 43 north, ranges 26 and 27 west.
Canadensis, L.; township 42 north, range 25 west.
valsamea, L.
negra, Ait.; township 43 north, range 27 west.
uja occidentalis, L.; township 43 north, range 27 west.
xus Canadensis, W.; township 48 north, range 35 west.

ENDOGENOUS PLANTS.

Araceæ.

ım triphyllum, L.; township 42 north, range 30 west.
lla palustris, W.; township 43 north, range 30 west.

Typhaceæ.

pha latifolia, L.

Archidaceæ.

lopogon pulchellum, Br.; township 45 north, range 28 west.
odyera pubescens, W.
gonia ophioglassoides, R. Brown; township 42 north, range 24 west.
pripedium acaule, Ait.; township 42 north, range 31 west.
parviflorum, Willa.; township 41 north, range 27 west.
spectabile, S. W.; township 41 north, range 27 west.

Smilaceæ.

nilax rotundifolia, L.

Liliaceæ.

ythronium Americanum, Smith.
lium tricoccum, A.
sessilifolia, L.; township 43 north, range 30 west.
perfoliata, L.; township 43 north, range 28 west.

Melanthaceæ.

nllium erectum, L.; township 42 north, range 32 west.

Cyperaceæ.

riophorum Virginicum, L.
rex plantaginia, Lam.; townships 42 and 43 north, ranges 24 and 25 west.
folliculata, L.; township 42 north, range 29 west.

Gramineæ.

ptatherum racemosum, S.; township 43 north, range 31 west.
nicum pubescens, L. K.
omus pubescens, M.; township 43 north, range 31 west.

ACROGENOUS PLANTS.

Equisetaceæ.

Equisetum hyemale, L.; township 42 north, range 26 west.
sylvaticum, L.; township 41 north, range 25 west.

Lycopodiaceæ.

Lycopodium complanatum, L.
deudroedeum, L.; township 42 north, range 24 west.
annotinum, L.; township 42 north, range 31 west.
lucidulum, Mx.

Filices.

Polypodium calcareum, Sm.
Woodwardia Virginica, S. W.; township 42 north, range 27 west.
Adiantum pedatum, L.; township 42 north, range 27 west.
Botrychium Virginicum, W.

GEOLOGICAL REPORT OF BELA HUBBARD.

General report upon the geology and topography of the district on L[ake] Superior subdivided by S. W. Higgins and Bela Hubbard, dep[uty] surveyors, in 1846; *with tabular statement of specimens collected.*

Topographical features.

The district embraced by the returns of subdivisions herewith m[ap] lies in two divisions, which have somewhat distinct geological as w[ell] as topographical features, though belonging to the same general syst[em]. The first includes townships 51, 52, and 53 north, ranges 37 and [38] west; townships 52, 53, 54, 55, and 56 north, ranges 35 and 36 w[est] and townships 53 and 54 north, range 34 west; or that portion of [the] whole district which lies east from the Ontonagon river, and west [of] Portage lake. The second includes township 51 north, ranges 41, [42], 43, and 44 west, being that portion of the surveyed district which [lies] west from the Ontonagon, and embraces the northerly segment of [the] Porcupine mountains.

The portion included in the first division presents, as its most strik[ing] features, a broad range of elevated and knobby country, occupied or i[m]mediately underlaid by trap rocks. The part thus characterized, occup[ies] an average and very nearly uniform breadth of about four miles. A l[ine] drawn diagonally from near the southwest corner of township 51 north, ra[nge] 38 west, to the northeast corner of township 54 north, range 34 w[est] would pass along nearly the central and most elevated portion of [the] range. These elevated ridges and knobs do not exhibit the same con[ti]uity that distinguishes the trap ranges of Keweenaw point. In its gen[eral] features the trap region exhibits a high and rolling country, occasionally ri[sing] into knobs which attain an elevation, as estimated, of from 400 to 900 [feet] above Lake Superior. It is much broken by the deep valleys of the la[rge] streams, which in several instances cut entirely across the trap. This

ne case with Misery, Sleeping, and Fire-steel rivers, which in some places cross the hilly country through gorges a hundred feet in depth. Though irregular in size and frequency, the hills have a general course northeasterly and southwesterly, and are crossed at nearly right-angles by valleys and the ravines of streams.

The ascent to the hilly region from the lake coast is very gradual, the whole intervening country being level, or but gently undulating. This portion is watered by the larger streams, which, after leaving the hills, descend to the lake with a very equable, though rapid flow, and in a very direct course, conformable with the dip of the rocks. Fire-steel river may be ascended by canoes to its sources in the hills. Few of the other streams can be considered as thus navigable, even for much shorter distances. The numerous branches of these streams, and smaller streams which rise at points intermediate between the hills and the lake coast, water the whole region abundantly. Among the hills in township 53, ranges 35 and 52 north, 34 west, are numerous lakes of very pure water, occupying areas of a few acres to a half mile.

The trap portion of the country, which, in the vicinity of Portage lake, is distinguishable only by low rolling hills, timbered chiefly with the sugar-maple, rises gradually in proceeding southwest, and the protrusion of the rock through the soil becomes more and more frequent, until the highest elevation is attained near the Ontonagon river. The hills have there reached an elevation probably of little less than 1,000 feet, and present on the south a bare and almost perpendicular cliff of rock. At the sources of Fire-steel river some knobs were estimated to be 900 feet in height, while westward from this none were estimated to exceed 700 feet. The highest of these knobs does not exceed 100 feet above the surrounding valleys, and is usually much less. Their steepest escarpments are generally on the south and east.

In general all the rocks are covered, more or less, with the mixed materials of the drift formation and the tertiary clays, though the character of the soils partakes somewhat of, and is influenced by, the nature of the underlying rock. The immediate soil is therefore, in great part, a sandy loam, the materials of which are derived from the primary trap and sandstone rocks. In but few places does the clay constitute the upper soil, though it is frequently found underlying at the depth of a few feet, and occasionally the soil itself is a red clay loam.

The level or undulating country between the trap hills and the lake is, in general, be denominated second-rate land, portions occasionally deserving to be called first-rate, but more often descending to third-rate. Hemlock is the prevailing timber, mixed with sugar, yellow birch, balsam, cedar, and alder. Marshes and swamps, mostly covered with cedar, are of occasional occurrence, and sometimes occupy areas of several miles.

The approach to that portion of the country which is underlaid by trap, is, in general, marked by an almost immediate change in the character of the vegetation; that of the latter being a luxuriant growth of sugar-maple, elm, birch, hemlock, and pine. The sugar tree is greatly predominant, a large proportion of which is of the varieties known as the curled and bird's-eye. Some red oak is found on the ridges, and pines occur scattered over the country. The trees are of large size, it being not uncommon to find pines of five feet diameter, and sugar trees of two feet. The soil varies from a coarse gravel to a fine dark loam, usually inclining to sandy, but occasionally argillaceous. This soil is composed in part of drift, being

a mixture of pebbles, from the size of a hen's egg down, of every vari of rock known in the region, with quartzose sand, and in part of dis tegrated portions of the rock below. Together these constitute a so easily tilled, yet sufficiently tenacious, and which will, without doub prove exceedingly fertile. Indeed, when it is considered that the su stances which compose the trap rocks are eminently calculated to gi fertility, an observation which is confirmed by the fact that some of t most fertile soils in Europe are from this rock, we may not hesitate pronounce the soil of the trap country of Lake Superior to be unexcell for the varied qualities of a good soil, by any in the world. Nor sho we neglect to notice that among the pebbles of the drift portion of this well as nearly all the soils examined, are many of limestone. They found from the lake shore to the summits of the highest trap ranges, a in sufficient abundance to affect, without doubt, the character of the s We have but to add these facts to the advantages afforded by a fin varied surface, abundant water and water-power, a climate admitting production of all the staple articles of the northern States—in fact, mu more equable than that of New England—to be convinced that this regi in an agricultural point of view, has been far underrated.

The huge uplifts which compose the Porcupine mountains appro much nearer the coast of the lake than the trap rocks of the other vision of the surveyed district; the ascent is more bold, and they so times form abrupt and lofty precipices. While the knobs of these ran have no continuous direction for any very considerable distances, t preserve a general parallelism with those of the Keweenaw range: n strictly, they will be found conformable to the general trend of the co They compose a series of conical knobs, with intervening elev ground, arranged in three somewhat distinct parallel ranges. The c tinuity is, however, much broken up, and frequent outlying knobs a seeming confusion and want of any general bearing. In townshi north, range 43 west, the outermost of these ranges rises into a conspicuous and continuous ridge, having an elevation, as estimate from 900 to 1,050 feet above Lake Superior, at a distance from it of and a half mile. This ridge, which continues unbroken for nearly miles, slopes gradually down to the coast on the north side, while on south the descent is precipitous over a cliff of trap rock, having an alt perpendicular height of from 300 to 400 feet. The principal knobs of other ranges vary from 500 to 800 feet, in one instance rising to the mated height of 1,000 feet above Lake Superior.

The most considerable streams of this district are Iron, Carp, Pewebek rivers; the former is by far the largest, having an averag more than two chains width through the district. In general the stre are small.

Except where rock shows itself in the steep escarpments of the l and occasionally in the beds of the streams, this whole country is cov with the drift formation, consisting of deposites of red clay and s The union of this with the disintegrated rock of the country, has g character to the soil and timber. Sugar-maple predominates throug the trap and elevated portions, while hemlock is the prevailing tir upon the lower lands.

This effect of the underlying rock upon the character of the vegeta is particularly observable when, from the summit of a high knob, the

ders over the extended landscape. It sees cone after cone rising up amid open groves, to which the sugar-maple, lynn, and elm, mingled a few pines, birch, and evergreens, give an enlivening character, ing the hills to their summits, while over the plains below, based the sandrock, is spread more sombre coloring, occasioned by the dence of hemlock and cedar, the dark shades of which are some- relieved by the light foliage of the silver birch and aspen, or the t berries of the mountain ash.

Tertiary clays.

roceeding westerly from the Portage, portions of the coast inter- between the cliffs of sandrock will be found to be frequently ed of clay. Between Salmon Trout and Elm rivers, these rise ry uniform elevation to from 50 to 80 feet. The clay is of a red- lor, but considerably lighter than that of the red sandrock. It numerous pebbles, which are composed of sandrock, the sev- e ties of trap, granite, and quartzose rocks; when found suffi- ee from these, it is well adapted to practical uses. There is a alogy between the character of the argillaceous material which s this deposite, and that which makes up a large portion of the erate and slaty trap, hereafter described.

eposite is found to cover the sandrock very universally from t far into the interior, and not unfrequently surrounds the bases ls and fills the sides of the gorges, though almost everywhere it is nd generally concealed by the sand and gravel of the drift formation. osite thickens in proceeding westward, and is seen on the On- at about five miles from the mouth, in a cliff of a hundred feet in Farther up the stream it increases in thickness, and at the forks o steep hills of 200 to 300 feet, resting upon the trap. Westerly is basin it again gradually thins, and among the Porcupine hills r seen. In this clay have been found many large boulder masses er among the branches of the Ontonagon.

Rocks.

e portion of the surveyed district eastward from the Ontonagon ee classes of rocks were met with, and these have an order of suc- analogous to those of Point Keweenaw, viz: trap, conglomerate, ndrock; the characters of each of which will be separately described. he Porcupine mountains the several rocks may be said to form of concentric arcs, invariably dipping outwards. The character egularity of this change in the dip is very apparent on the coast, is composed of a trappose brown sandrock. The dip is seen to shift ally from an easterly direction at Iron river, to a northwesterly one at river, varying from 20° to 45° in amount. The rocks of the hills, the intervening valleys, compose an alternating series of beds of stone, amygdaloid, and red slaty trap, trap conglomerate, and trap- sandrock. These are flanked by a black argillaceous slate, which ersperse between the outer mass of mixed conglomerate and sand- and the red variegated sandrock, and makes an outcrop in one

place only in the district, and that over a very limited area at the mouth of Iron river.

Following the streams at the bases of the hills, these several varieties of trap, sandstone, and conglomerate rocks may be sometimes seen successively dipping beneath each other several times in the space of a few rods, the beds varying from three or four to several hundred feet in thickness. So much are the rocks concealed from observation, as to render it impracticable to determine the number or exact order of these alternations, or the proportions they bear to each other. The greenstone and amygdaloid rocks seem to predominate. The total thickness of these beds must be very great, and though this portion of the district (embracing, as it does, but a mere segment of the probable area of the trappose rocks) does not furnish sufficient data for a full conclusion, some estimate may be arrived at, assuming the average dip to be 20°, and the average distance from the coast to the correction line: allowing the line of dip to be five miles, the total thickness of all the rocks which compose that portion of the Porcupine ranges, which is within the present survey, is 9,240 feet. This calculation, it should be observed, does not include any portion of the red and gray sandrock formation, the rock of the coast west from Iron river being considered as a member of the conglomerate. In fact, all the rocks within this area may be considered as of a trappose origin.

Trap.

The great trap range already described, extending from the Portage lake to the Ontonagon river, as it is but a prolongation of that of Keweenaw point, bears also a close analogy to the greenstone and amygdaloid of the latter. The high knobs are composed mostly of greenstone, which is usually hard and compact. It sometimes approaches a crystalline structure, in which the felspar and hornblende are aggregated in distinct grains, but generally the constituent parts of the mass are so blended as not to be separately discernible to the eye. This character of rock is, however, far from composing the whole of the great mass designated as trap, nor does it seem possible to consider the latter as a single dike or contemporaneous uplift; for though the compact variety usually composes the greater part of the cliff, the entire mass will be found to consist of *regularly disposed and alternating beds of greenstone and amygdaloid*, the latter sometimes giving place to epidote. The occurrence of this, as well as of the other minerals of the trap, will be more particularly alluded to when we come to describe the relations of the minerals and veins to those rocks. These alternating beds vary in thickness from two to twenty feet, commonly, though they sometimes much exceed this. They give an appearance of stratification to the mass, and their dip is very uniformly towards the lake, and at right-angles to the bearing of the hills.

These observations will apply also to that portion of the surveyed district embracing the Porcupine mountains. Associated, however, with the greenstone and amygdaloid of that country, appears an argillaceous and silinous rock, which, though we have classed it among the trap rocks, is very distinguishable from all the other varieties of trap, and is therefore entitled to a separate description. This rock occurs in belts, alternating

ith those which make up the mass of the Porcupine ranges, and possily may be regarded as a *volcanic mud*, altered and hardened by its vicinty to rocks of igneous origin.

The arrangement exhibited by these rocks has been alluded to as one of *pparent stratification*. While we desire to avoid any theoretical conclusons as to the mode of their formation, we cannot but observe that the haracter of the entire trap formation is rather that of a succession of verflows, than of simultaneous uplift in mass; in other words, it may be onsidered as made up of *beds* of the different kinds superimposed upon ach other. It has been already observed that in the Porcupine ranges, ie trap, sandstone, and conglomerate beds compose part of these alterations, in deposites of greatly varying thickness. It is difficult to reoncile the frequency of these interpositions, the comparative thicknesses f the beds, and the few signs of disturbance, with the supposition of a otrusion of the trap, as an igneous mass from beneath, through the rata of the overlying sedimentary rocks. We would not be understood assert that no uplift of the trap has taken place, but merely to distinuish between the mode of formation of the several rocks, and the subsequent and general uplift, by which the whole series has been thrown from horizontal, and inclined at the angle at which we now find them.

In common with all the rocks, the trap is traversed by frequent joints r fissures. This is particularly apparent in the greenstone, which is cut y three series of such fissures; and it is observable that these have a corespondence with the strike and dip of the mass, as well as with its meulliferous veins. Of these joints, one is conformable in its course to the rike of the beds, and its underlie conforms in direction to their dip, varing from 30° to 80° in amount. This is cut by another and vertical oint, the course of which is at right-angles with the first mentioned, and greeing with the line of dip of the beds. It seldom varies more than 10° om this direction or from a vertical. A third but less conspicuous joint ometimes cleaves both the others at nearly right angles, its underlie eing opposed to the first mentioned. Thus the greenstone is separated nto blocks of varying size, and approximating in form a cube or rectanular prism.

Red, slaty, argillaceous and silicious rock.

It has been already mentioned, that alternating with the several rocks hat compose the Porcupine mountains is a hard rock of red color, fineained, and sub-slaty in structure. It is evidently trappose in character, ut is at the same time quite argillaceous, and sufficiently silicious to trike fire under the hammer. Its color varies from a light to a dark brickd. In character and composition it bears a strong resemblance to the ementing portion of the conglomerate rock of the country. In some laces this rock is traversed irregularly by numerous small veins of calc par, and so filled is the rock with these as to give it a spongy appearance. ock of this character constitutes a step or elevated ledge upon the exeme northeasterly flank of the mountains, where it forms a cliff rising 0 or 15 feet above the superimposed amygdaloidal trap that composes the ill side below. The more compact variety is met with in several of the treams at the bases of the hills in T. 51 N., R. 42 west, and is in small

bands frequently of but two or three feet thickness, interposed l
greenstone and amygdaloid. Further south this rock is seen ris
occasional knobs, and appears to constitute a large proportion of t
body of trap rocks which unites the Porcupine with the Ontonagon

This rock, though sufficiently hard, will probably be found il
to building purposes, in consequence of the numerous joints by
is broken, frequently into fragments of less than an inch diamet
ores were discovered in connexion with this rock.

Conglomerate.

In the portion of the district eastwardly from the Ontonagon, th
be observed in a few places, resting upon the greenstone and amy
of the northerly escarpment of hills, and holding the same relati
tion as upon the northerly flank of Point Keweenaw range, a lar
of conglomerate. But while this formation agrees in position and
character with the latter, it differs from that in several of its featu
is a less continuous deposite, existing in apparently isolated bod
it is thus seen through townships 51 and 52, range 37, among th
waters of Fire-steel river, rising into conical knobs and rounde
having an elevation above Lake Superior of about 600 feet.
from here until beyond the Portage lake, this formation, if it
thinned entirely away, is covered by the drift too deeply to be
though a low, broad ridge, secondary to the trap ranges, may o
ally be seen skirting their southerly escarpment, which may wit
probability be attributed to the presence of this formation.

This conglomerate differs also from that of the northerly sid
weenaw point, it being composed of pebbles which are in gen
water-worn, and often quite angular. These are also less stro
mented, the mass being often so friable as to render it difficult
a perfect hard specimen. In both these respects this conglomer
a close resemblance to that of the southerly side of Point Ke
The cementing material is imperfectly silicious, and becomes
resolved at the surface into a fine reddish clay, which forms a fe
The analogous character of this clay to that of the great tertiary
has been already adverted to. The pebbles are invariably of tr
several varieties, and they vary in size from a foot in diameter to
tion of an inch, the average being two or three inches.

The conglomerate of the Porcupine mountain district is of simi
acter. It is seen rising on their northerly flank to the height of
and composes the summit of one of the conical knobs a few m
from Iron river. This large deposite is overlaid by a mass of amy
to which succeeds the brown trappose sandrock, or rather mix
rock and conglomerate, which constitutes the coast.

Besides these comparatively extensive deposites, several le
occur intermediate between the trap rocks that compose the chi
the Porcupine ranges. The latter sometimes assumes a slaty c
resembling the red slaty trap already described, in which the c
portion often constitutes more than half of the entire mass. F
impossibility of obtaining accurate data in regard to the dip, we
able to determine the thickness of the larger deposites with a
ness. That of any single mass will not probably exceed 2,

hough the aggregate thickness of the several beds may possibly exceed wice that amount.

Black argillaceous slate.

This rock has been already alluded to as occupying a position intermediate between the outer or trap sandrock of the Porcupine mountains and the red sandrock. It is seen in the bed and banks of Iron river, for almost two miles from its mouth, where it consists of layers varying in thickness from a half inch to two feet. The thicker strata are of dark gray color, but in the thin layers it approaches a black. The latter portion is fine-grained and highly argillaceous. The thicker strata are more coarsely grained, and approach the character of sandrock in the lower portions. Numerous small specks of mica are visible throughout the mass. In the texture of this rock there is so close an analogy to the red sandrock which overlies, that it may perhaps safely be regarded as a member of that formation.

Besides the well marked places of deposition, the rock is much traversed by joints; the most numerous, regular, and persistent of which have a course nearly north and south, or more commonly N. 10° to 20° W. These are crossed by another series, which have a course about N. 50° to 60° E.; but the latter are less regular, are often curved, and frequently stopped by the joints first mentioned. Both are nearly vertical. The fracture of the rock is conchoidal.

Though this rock makes but a very limited outcrop within the surveyed district, it is supposed to skirt the Porcupine mountain formations in a narrow band along the whole northerly flank, mostly beneath the waters of the lake, as far west as Montreal river; while to the eastward of these mountains it performs a more sudden curve, sweeping to the south, until it meets the trappose rocks of the Ontonagon range at their union with these of the Porcupine mountains. Its dip at the mouth of Iron river is 25° E. of N.; at three-fourths of a mile up it dips to the east, and at another half mile the dip is 20° S. of E., being from 18° to 20° in amount. Before reaching the Ontonagon this formation either thins out or becomes merged in the sandrock, for it was not met with east of that river.

Some minerals were found in this rock, which will be referred to under the head of veins.

Red, or red and gray sandrock.

This rock, the uppermost of the whole series in the portion of the surveyed district between Portage lake and the Ontonagon, is found making the other rocks on their northerly slope, and underlying the broad tract of level or undulating country between the hilly ranges and the lake coast. The latter consequently is composed of this rock, with the exception of some clay cliffs and broad layers of sand and shingle, as far west as Iron river. It is exposed in ledges of from 6 to 50 feet in height, composed of nearly horizontal layers of sandrock and shales. The latter are thin and fissile, breaking out in pieces seldom exceeding a half inch in thickness. The harder strata, which embraces nine-tenths of the whole mass, vary in thickness from an inch to several feet. In general

the upper portions of the cliffs are of hard and uniform strata, and very frequently of a light gray color; while the portions beneath, which are of a brick-red, are more soft and pliable, and portions consist of soft, thin shales. This character occasions the rock, where exposed to the action of the surf, to wear away irregularly. The cliffs in consequence often present a picturesque scene of caves, separated by rounded pillars, and roofed by the thicker overlying strata.

This rock is traversed by numerous and nearly vertical fissures or joints, forming a double series, the directions of which have a degree of uniformity, the result, undoubtedly, of some general law.

The most numerous of these have a general parallelism, and pursue very uniform straight lines; their course varying at different places in the district from 10° to 30° on either side of the meridian.

These are cut by a second series of joints at an angle with them of from 60° to 80°. The latter are less persistent and uniform than the former. This structure is sometimes rendered very conspicuous along the coast, where the harder strata have been brought by the dip to the water's edge. Here the *wasting* of the cliff is sometimes checked by one of these principal fissures, and presents a smooth and vertical wall of rock for a distance of several hundred feet, the uniform height and regularity of the layers giving the appearance of a work of art. It will thus be seen that this rock is cut by its jointed structure into rhomboidal-shaped masses, which are easily removable in blocks of from one to several feet diameter. Many of these would serve a good purpose for building. Westerly from Sleeping river, rock of a deep brown or Indian-red color composes the coast, the texture of which is somewhat more indurated than the other sandrock; and this, as well as the brown sandrock of the coast in the portion of the district west from the Ontonagon, is capable of furnishing much very durable material for building purposes.

Mineral veins.

If we regard veins as merely *fissures* in the rocky strata, that have afforded the most convenient receptacles for the deposite of mineral substances, we would naturally be led to look for mineral veins in most if not all the rocks we have been describing, for we have seen the manner in which these are all traversed by fissures or joints, which are often of great length and depth; and, indeed, we find this to be the case, to some extent, with each class of rocks, for each has its characteristic minerals, and these are most commonly aggregated in the form of veins, or filling the fissures in the rocky beds. Thus we find the fissures of the sandrock and conglomerate frequently filled with calc spar, barytes, the carbonates, oxides, and sulphurets of copper, &c.; but few, if any, large or important veins have been discovered that are productive to any valuable extent, unless in immediate association with trap rock.

The fissures alluded to as belonging to the jointed structure of the different classes of rocks are doubtless the result of a cause, or more properly a law, uniform and universal in its operations, and which has occasioned equal uniformity throughout each particular rock, in the size and directions of the fractures. In the *true veins* of the district, it is evident, we must look for some different or at least modifying cause, for, though pursuing a direct course, when considered in their entire length

the latter are both irregular or zigzag in outline, and of greatly varying width.

The black slate of Iron river affords good examples of the former kind of veins; the largest of the joints being sometimes filled with the sulphurets of lead, iron and copper. The most considerable of these mineral-bearing seams have a nearly north and south course, that being the direction of the most marked and persistent of the joints. They rarely exceed the sixth of an inch in width, though sometimes increasing to the fourth of an inch. Thus, apart from any unfavorable considerations that might be warranted by the character and position of this rock, the fissures would appear not to be sufficiently large and open to permit the deposite of much mineral, and we may therefore regard these veins as of little practical value.

The trap rocks are the only ones throughout this district which it is probable will afford veins of any practical importance. These rocks contain two classes of veins, both of which afford ores. One of these answers to the definition of *true veins*, being fissures nearly vertical, and which have been filled subsequently to the consolidation of the rock. The other we shall denominate *contemporaneous veins*, as answering nearly to that description, though, doubtless, also in part deriving their mineral contents from subsequent deposition.

It has been observed that the veins of the mineral district in general have a course at right-angles to the bearing of the rocks, or nearly so. This is true of the most important of the first class, or true veins; their courses seldom varying more than 10° from the line of dip of the rock, and corresponding to that of one of the series of joints by which, as already mentioned, the rock is traversed. These veins, in like manner, are vertical in their general direction downwards, but in the detail pursue the same zigzag course as is observed in their horizontal extension. These veins are connected frequently with smaller entering veins, which come in at various angles, usually a high one, and sometimes the several veins pursue a nearly parallel course for considerable distances before union.

When these veins, as is often the case, occupy lines of displacement, or shift in the rock, their place is sometimes indicated by a flexure of the cliff, and by valleys longitudinal to the vein; and, no doubt, were the underground country more fully explored, there would be found a system of displacements, cross-courses, and heaves, perfectly analogous to similar phenomena exhibited in most mining countries. For the reason alluded to, these were noticed in few instances only, though they are doubtless of frequent occurrence: in fact it is rare to find an instance of the meeting of a cross-course and vein where a displacement of one or the other has not taken place. Shifts or throws were noticed, in extent from a few inches to several feet.

The direction of the cross-courses frequently corresponds to the line of bedding of the rock, and they apparently conform to it, though usually their course is zigzag, like that of the veins, and they preserve only a general horizontal direction. They are distinctly defined by walls; and though, from their apparent conformability to the bedding of the rock, they may sometimes be mistaken for the contemporaneous veins, they will be found to be of different character. Our observations lead to the conclusion that the cross-courses resemble the true veins in their mineral contents, but are inferior in size and productiveness. Both copper and silver were detected in them; the former in a native state, and as a sulphuret.

The minerals most frequently noticed in the veins were steatite, calc spar, zeolite, quartz, prehnite, barytes, and epidote: with these more rarely thomsonite, analcime, and a few others. Native copper, and occasionally, though rarely, native silver, accompany these minerals—sometimes disseminated through the veinstone in small irregular masses—frequently so minute as to be detected only by the aid of a powerful lens; at other times filling the central portion of the lode with large masses of the metal in a nearly pure state. Native copper is also found not only associated immediately with these minerals, but disseminated in small particles through the rocky portions of the lode, and even sometimes filling the cells of the amygdaloid for several feet beyond the walls.

As the associated minerals are not unfrequently the only guide to the explorer for metallic veins, it may be important to allude with more particularity to the extent to which these are found associated with the ores. Among the most abundant and characteristic minerals in the largest and most productive veins is a very dark-colored steatite, or chloritic slate. It is of a dark green color, and has a soapy feel. The same mineral is found very frequently filling the amygdules in the trap. With the veins it occurs generally in masses, often forming a coat to the veinstone, varying in thickness from an inch to a foot. The presence of this mineral in quantity, seems to be indicative of a "good ground" for metal. Some form of zeolite, usually laumonite or stilbite, ranks also as one of the most characteristic minerals. These have a crystalline form, and are usually in intimate connexion with the copper in its native state. Epidote occurs frequently, like the zeolites, in crystalline form, and like that, too, associated with the particles of native metal; but it often appears in large amorphous masses, though in this form it more frequently belongs, within the district under consideration, to what we designate as contemporaneous veins. Prehnite is found accompanying the native copper in most of the veins, and, though in less quantity than the minerals just mentioned, may be considered highly characteristic. Calc spar and quartz, with rocky matter, generally make up the greater portion of the vein proper, and may be said to be the almost universal matrix of the ore; but, though almost always accompanying the ore in the veins, their presence was not regarded as so reliable a test as the others. All the remaining minerals were found only in comparatively small quantity, and always in a crystalline form.

Native silver has been found in nearly all the veins that have been explored to much extent; yet we are not aware that anywhere in the mineral country has it been found in such abundance as to justify any other than the cautious conclusion of Dr. Houghton, that the occurrence of this metal is *rare*. Probably in few instances does it occur in sufficient quantity to pay an additional profit after the cost of separation.

Contemporaneous veins.

Another association in which copper is found is of very frequent occurrence in the district under review, though we are not aware of its occurrence on Keweenaw point. We allude to what are denominated *epidote veins*. These are found having a course nearly at right angles with the veins previously described, and they differ also in the circumstance that the most prevalent mineral is epidote, in an earthy or uncrystalline form.

With this is mixed more or less native copper, generally in small particles, but often composing a large proportion of the whole mass. Repeated observations have led us to the conclusion that this form of occurrence of these minerals cannot be said to constitute true veins, in the technical sense of the term.

It has been already noticed that epidote is one of the minerals generally found associated with the contents of true veins. In the veins of Keweenaw point, comparatively little of this mineral was observed. West from the Portage, and particularly in the trap ranges at the Ontonagon, and among the Porcupine mountains, it assumes a greatly increased proportion, and the amygdules of the trap are often filled with it where veins are absent. These amygdules frequently coalesce into larger and irregular masses, beds, and veins. It then seldom puts on a crystalline form, but becomes an earthy mass, or compact epidote rock. These *beds*, as they may be called, are frequently quite extensive. They generally follow the strike of the containing rock, appearing as an interstratified portion of it, and dip regularly with the surrounding masses or rocky strata. These beds have seldom well-defined walls, though a very distinct line of separation is often apparent where the bounding rock on the one side is greenstone, and amygdaloid on the other; the epidote often occurring at the junction of these two rocks, or supplying the place of the latter. In general, the epidote is so blended with the trap near the junction as to leave no regular or distinct line of demarcation; and in fact the whole mass often partakes so much of the character of the including rock, that it is scarcely possible to regard the two as distinct formations. The thickness of these beds varies from a few inches to ten feet, and they have been traced for the distance of half a mile. Similar beds occur, though rarely, in the conglomerate.

These beds are traversed by the true veins of the country, and the productiveness of both in metal is usually increased at the junction. In a few instances, seams of clay were noticed running longitudinally with the beds.

Associated with this form of epidote are occasional bunches and irregular veins of radiated quartz, calc spar, zeolite, steatite, and carbonate and oxide of copper. The copper which accompanies the minerals of these beds is most frequently in a native state, disseminated irregularly and in small particles, but sometimes in such quantity as to produce a very rich ore. Beds or veins of gray sulphuret of copper are sometimes interstratified with the matter of the veinstone. It is very common, however, to find large masses of the epidote in beds, and blending with the other materials of the trap, but apparently destitute of metallic minerals.

The accompanying sections will serve to illustrate the general descriptions contained in this report.

BELA HUBBARD,
Deputy Surveyor.

Catalogue and description of mineral specimens collected in on Lake Superior subdivided by Messrs. Hubbard and Hi

N. B.—The place on the lines where the specimen was observed, is given links—*north* from the south end of the line, or *east* from west end, unless ot The name of a color in *italics* indicates a high degree of such color.

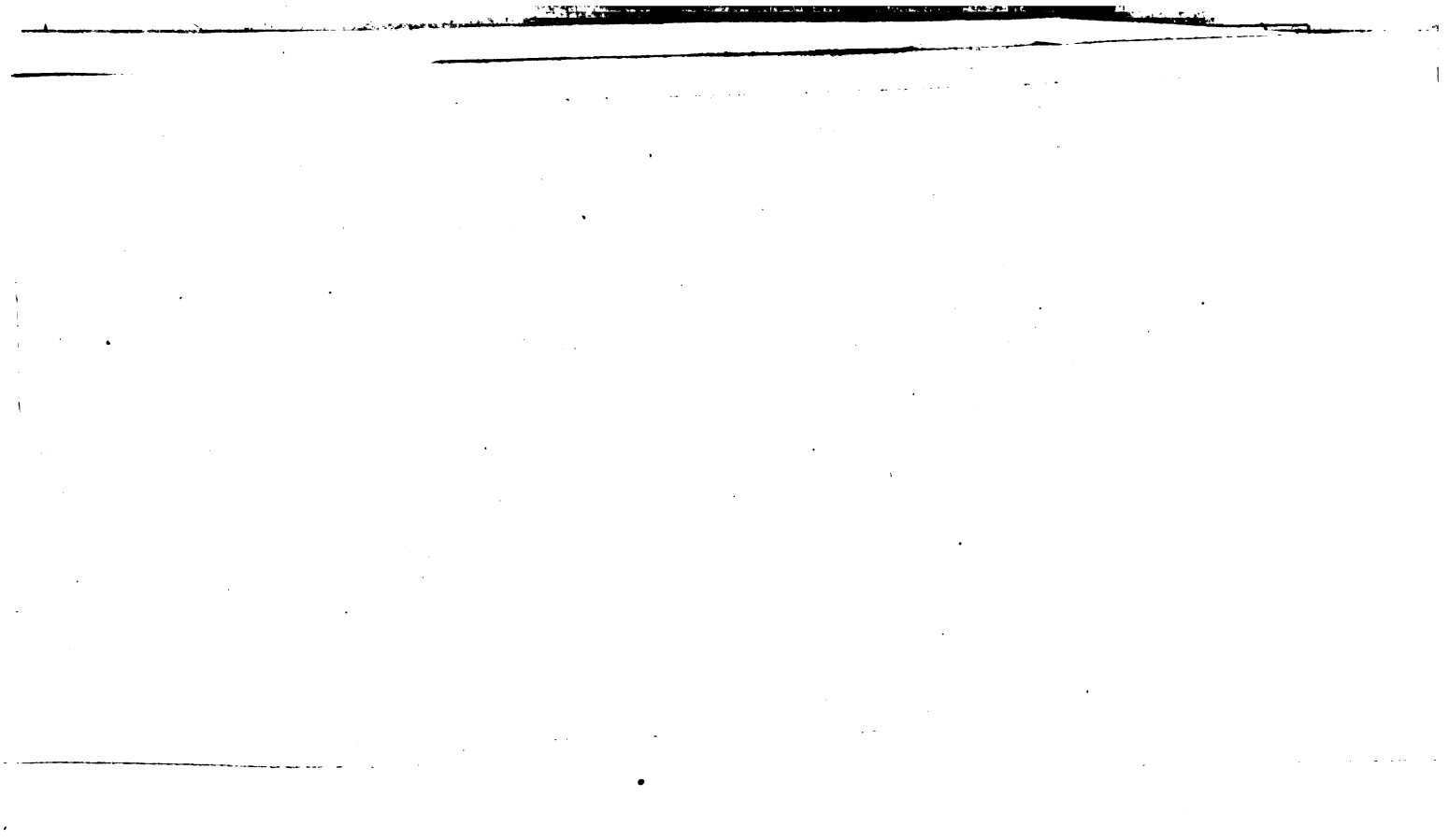
No. of specimen.	Between sections	Distance.	Description and remarks.
		Chs. lks.	*Township* 51 *north, range* 44
A 11	25 & 36	75 00 E.	Trap, semi-crystalline, *dark* gray; hill.
	23 & 24	18 00	Sandrock, conglomerate; lake coast; di
	23 & 26	25 00	Do do do
B 16	27	5 00	Black slate, somewhat argillaceous; dil course southeast.
17	27	5 00	Calc spar, with grains of quartz; vei lake coast.
			Township 51 *north, range* 43
A 7	23 & 24	60 00	Trap, dark gray.
B 11	13 & 14	24 00	Trap, dark gray; fine grained.
12	13 & 14	.....	Amygdaloid; amygdaloidals, filled wi dote, spar, &c.; wall of rock 300 1,050 feet above Lake Superior.
	11 & 12	44 00	Conglomerate sandrock; lake coast; di 10 west.
A 16	15 & 22	34 00	Trap, amygdaloid, dark gray; summ feet high.
18	9 & 10	15 00	Sandrock; lake coast; dip north 45 de
9	32 & 33	5 00	Red trap, porous; pores filled with qu of hill, at base; 630 feet high.
B 14	28 & 33	19 00	Amygdaloid, dark gray, hard; variabl
13	28 & 33	64 00	Red trap quartzose, hard; low ledge; d
14	28 & 29	7 00	As above, B 14.
A 15	20 & 21	16 00	Trap, semi-crystalline, *dark* reddish gr cliff 375 feet high.
	16 & 17	18 00	Sandrock, red; dip north 30 deg.
A 14	29 & 30	64 00	Trap, semi-crystalline, *dark* gray; s 900 feet.
13	20 & 29	43 00	Trap, semi-crystalline, dark gray; s 900 feet.
	18 & 19	73 00 W.	Sandrock, brown; lake shore; dip nor
	17 & 18	39 00	Conglomerate sandrock, brown; lake s 20, west 20 deg.
			Township 51 *north, range* 42
A 4	25 & 36	38 00	Sandrock, dark reddish brown; ledge f northeast 30 deg
1	13 & 24	4 00	Sandrock, argillaceous, dark gray; fine of stream 30 feet; dip vert. (?)
2	13 & 24	69 00	Sandrock, coarse brown; bed of Iron
19	13	river	Black argillaceous slate, with sulphu iron; bed and falls of Iron river.
5	27 & 28	70 00	Sandrock, hard, brown, with numerou of spar; "loose rock."
B 2	22 & 27	5 00	Epidote and calc spar, with copper (n in trap. Union Company shaft.
3	22 & 27	5 00	Epidote and calc spar, with native cop trap. Union Company shaft.
4	22 & 27	5 00	Epidote, (earthy,) with copper (nativ trap. Union Company shaft.

Catalogue of mineral specimens—Continued.

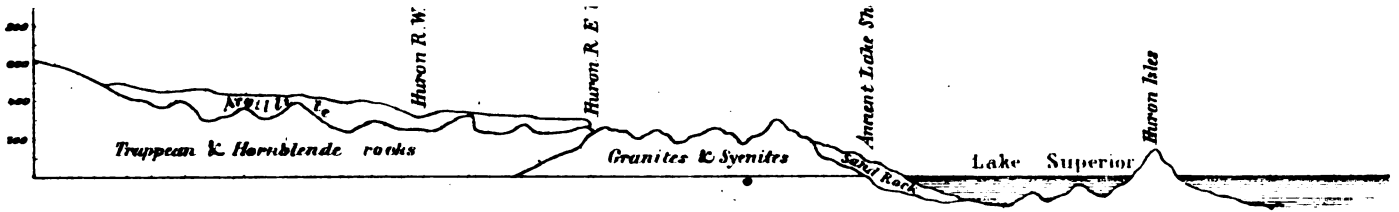
No. of specimen.	Between sections	Distance.	Description and remarks.
		Chs. lks.	
	22 & 27	29 00	Amygdaloid; amygdaloidals, filled with spar and steatite; bank 15 feet.
	15 & 16	33 00	Amygdaloid; dip north 10 deg.
	16 & 21	36 00	Red trap (or altered sandrock?;) silicious, with calc spar; summit of knob 520 feet; var. 4 deg. east.
	8 & 9	26 00	Conglomerate, of the brown sandrock; lake coast 25 feet; dip north 20 deg.
	29 & 32	14 00	Trap, dark gray; sparry; stream.
	29 & 32	42 00	Trap, reddish gray; sparry; high rolling land.
	20 & 29	22 00	Conglomerate of trap, ledge; var. 4 deg. east; dip southeast.
	19 & 30	57 10	Amygdaloid; amygdaloidals, filled with epidote, quartz, and calc spar; bed of stream.
	17 & 20	22 00	Amygdaloid, soft and sparry; bed of stream.
	17 & 18	47 00	Conglomerate; boulder?
			Township 51 *north, range* 38 *west.*
4	35 & 36	17 00	Trap, (brecciated,) knob 300 feet high.
3	35 & 36	46 37	Trap, crystalline, dark gray; knob.
5	34 & 35	3 00	Amygdaloid; amygdaloidals, filled with epidote and quartz; knob 550 feet; foot of hill.
6	19 & 20	37 50	Red variegated sandrock; bed of stream; dip hor.
			Township 52 *north, range* 38 *west.*
11	20 & 21	.....	Sandrock, variegated, red and gray, micaceous; bank of river; ledge 15 feet; dip horizontal.
	22 & 27	17 85	Sandrock, variegated; bed of river; dip horizontal.
	21 & 28	10 00	Do do do do.
			Township 53 *north, range* 38 *west.*
11	24 & 25	34 50	Sandrock, dark red, micaceous, striped; falls of Sleeping river; 15 feet over this rock.
2	29 & 30	.....	Sandrock, dark brown; coast; dip northwest 25 deg.
	16 & 17	9 50	Sandrock, red; coast; dip northwest 20 deg.
1	30 & 31	61 00 W.	Sandrock, (as above, D 1;) coast; dip northwest 25 deg.
			Township 51 *north, range* 37 *west.*
3	22 & 23	55 80	Trap, compact; *dark* color; in stream deep ravine.
	22 & 23	50 00	White sandrock; hill.
	10 & 11	26 00	Trap; knob 30 feet.
	10 & 11	34 00	Trap; knob 20 feet.
	10 & 11	34 82	Conglomerate; knob.
	10 & 11	58 00	Trap; knob.
	10 & 11	70 00	Do.
	2 & 11	7 00	Trap; ledge perpendicular? 30 feet.
	2 & 11	11 50	Trap; knob rising out of level ground 30 feet.
	2 & 11	17 50	Trap; knob; course north and south 50 feet.
	2 & 11	20 00	Conglomerate; ledge 20 feet.
3	2 & 03	28 00	See above; wall 15 feet perpendicular, northwest and southeast.
2	2 & 03	57 00	Trap, crystalline, gray; bare knob 20 feet.
	33 & 34	40 00	White sandrock, (supposed;) high poplar hill.
	21 & 22	28 00	Trap; knob 50 feet, north and south.
	21 & 22	32 00	Trap; ledge 12 feet, perpendicular.

Catalogue of mineral specimens—Continued.

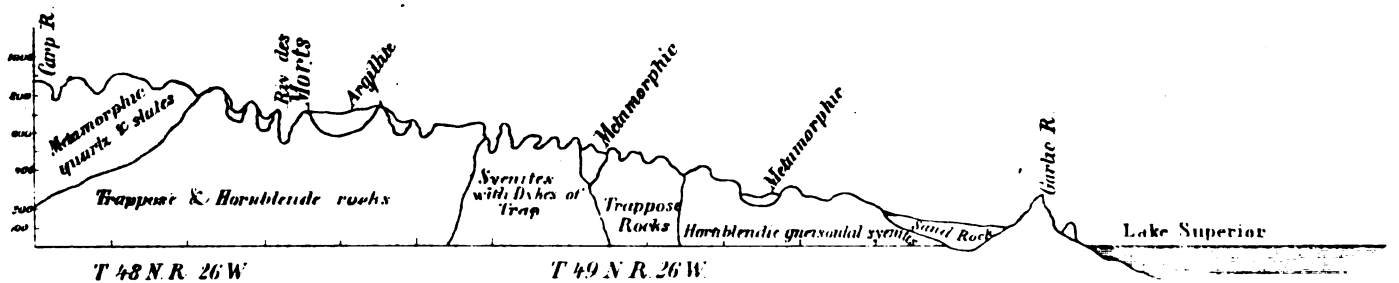
No. of specimen.	Between sections	Distance. Chs.	lks.	Description and remarks.
	21 & 22	49	83	Trap; high knob, north-northeast.
	15 & 22	23	50	Trap; summit of ridge 700 feet, and east end of ledge 20 feet, perpendicular.
8	10 & 15	14	74	Trap; ascend C 2; slope east.
	10 & 15	60	00	Trap; ridge, northeast and southwest.
	10 & 15	65	00	Trap; summit of ridge, southwest.
	10 & 15	72	00	Trap; ascend C 8; ledge.
C 7	16 & 21	15	00	Trap, crystalline, reddish gray; knob.
	16 & 21	21	00	Trap; summit, steep on southeast side.
	16 & 21	53	00	Trap; ledge 50 feet perpendicular, 900 feet above Superior.
	16 & 21	69	00	Trap; knob.
	16 & 21	70	00	Trap, foot of hill, 400 feet above Lake Superior.
4	16 & 17	14	00	Trap; amygdaloid, with sad. quartz, red-green; a daloidals, filled with quartz; in stream in ravi
	4 & 5	73	00	Conglomerate; in stream.
	17	.....		Conglomerate; high knob in interior of section.
	31 & 32	75	00	Trap; knob 100 feet, northeast.
	29 & 32	W.	corner.	Trap; knobs.
	31 & 32	2	50 W.	Trap; ascend ledge 40 feet; 120 feet in steps.
	31 & 32	4	00	Do do do do.
	31 & 32	6	00	Do do do do.
	31 & 32	16	50	Trap; knob, 2 chains north of line.
	31 & 32	21	31	Trap; ascend knob 800 feet above Lake Superior
5	31 & 32	31	55	Trap; very granular greenstone, greenish gray; foot of hill.
	29 & 30	5	00	Trap; summit of knob.
	29 & 30	10	00	Trap; summit of knob, east and west.
	29 & 30	14	00	Trap; knob.
6	30 & 31	5	50 W.	Trap, amygdaloidal, *dark* gray; knob, 40 feet.
D 9	.....	.....		Greenstone, dark reddish gray.
10	.....	.....		Do do.
7 & 8	20 & 21	27	53	Altered sandrock? stream.
				Township 53 north, range 37 west.
	18	29	00	Calc spar and sulphuret of barytes; coast meander vein.
				Townships 52 and 53 north, range 36 west.
E 6	11 & 12	31	50	Greenstone trap, dark gray; knob, southeast slope
	11 & 12	32	00	Trap.
	11 & 12	53	50	Same as E 6; trap hills, course northeast and so west.
7	11 & 12	55	80	Trap, compact, dark gray; trap hills, course no east and southwest.
5	11 & 14	30	00	Greenstone, reddish gray; trap hills.
2	2 & 11	34	50	Greenstone, compact, gray; trap hills, north slope
1	2 & 11	62	00	Same as E 6; middle of range.
3	16 & 21	9	00	Epidote, close-grained, but crystalline, in com trap; summit of hill, and south escarpment.
4	16 & 21	9	00	Trap, conglomerate; in conjunction with trap.
15	36	.....		Veinstone, quartz, and epidote, with native cop from trap knob.
D 11	13 & 14	.....		Sandstone, brown, fine-grained; bed of Elm river.



View of the Syenite hills, as seen from Pine River Bay
Lake Superior.



Section from S.W. Cor. of T. 51 N.R. 30 W. to Huron Isles Lake Superior. 16 miles

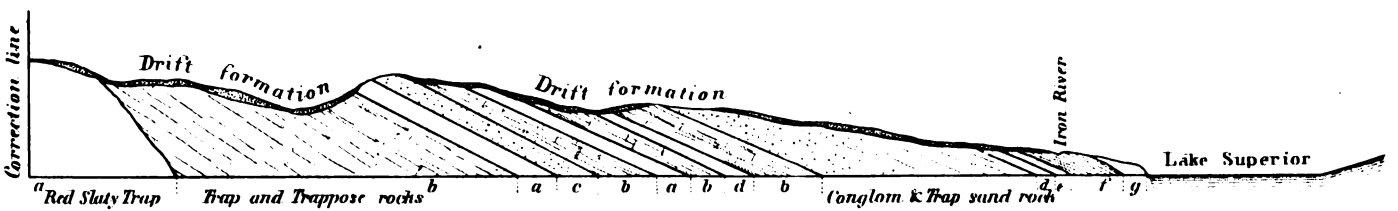


Section, from mouth of Garlic river, Lake Superior to S boundary of T 48 N.R 26 W. 15 miles

Hor scale 2½ miles to the inch. Vert scale 1000 feet to the inch

Porcupine Mountains

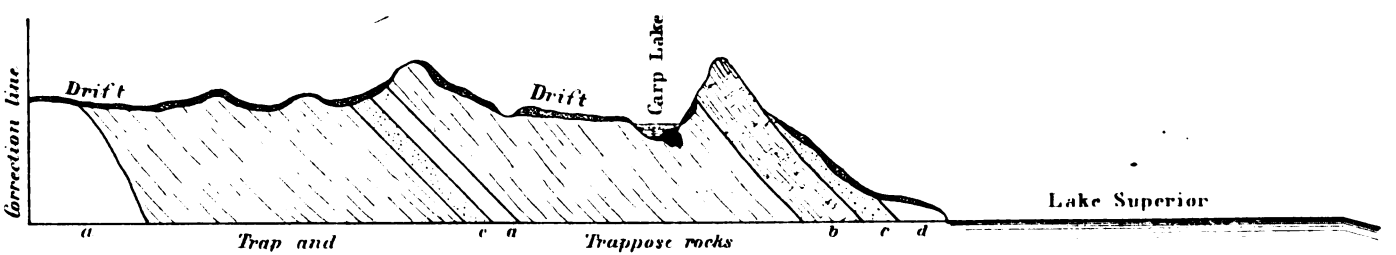
as seen from off Fire Steel River



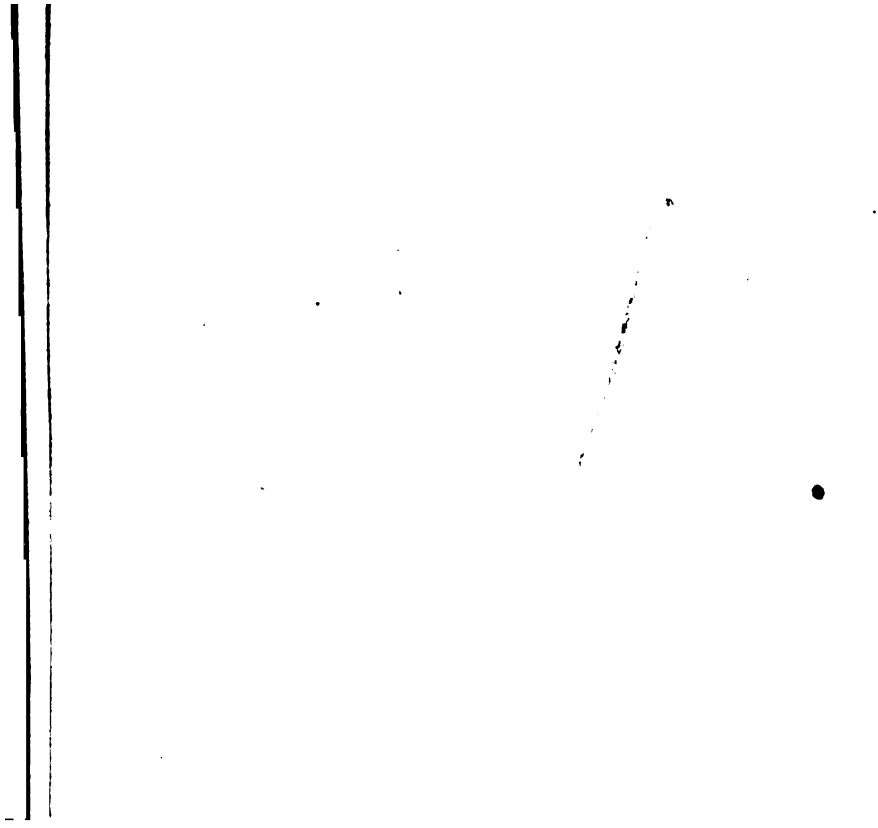
Section from S.W. Cor. of T. 51 N. Range 42 W. to N.E. Cor. of same at Lake.

Hor. scale 2 miles to an inch. — Vert. 1000 feet to the inch.

(a) Red slaty Trap, (b) Amygdaloid & Green stone Trap, (c) Conglomerate, (d) Trap sand rock, (e) Coarse Gray sand rock, (f) Slate, (g) Red sand rock.



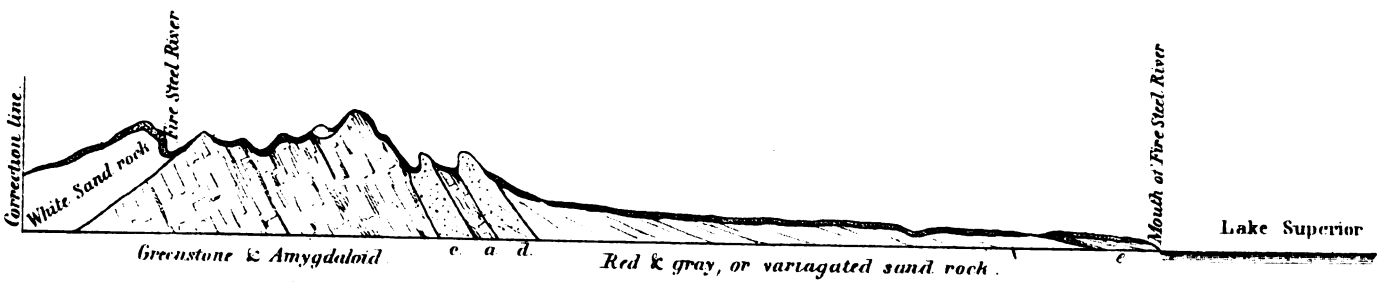
Section from S.E. Cor. of T. 51 N. R 43 W. N.W. to Lake Superior



View of the Trap ranges from the Forks of the Ontonagon River

Looking West.

Looking East.



***Section** from S.E. Cor. of T 51 N. R 37 W. to mouth of **Fire Steel River** (16 miles)*

Hor. Scale ½ inch to the mile. Vert. 1200 ft. to an inch.

(a) Amygdaloid (c) Conglomerate (d) mixed conglom & sand rock (e) Brown sand Rock.

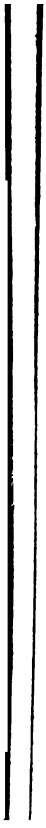
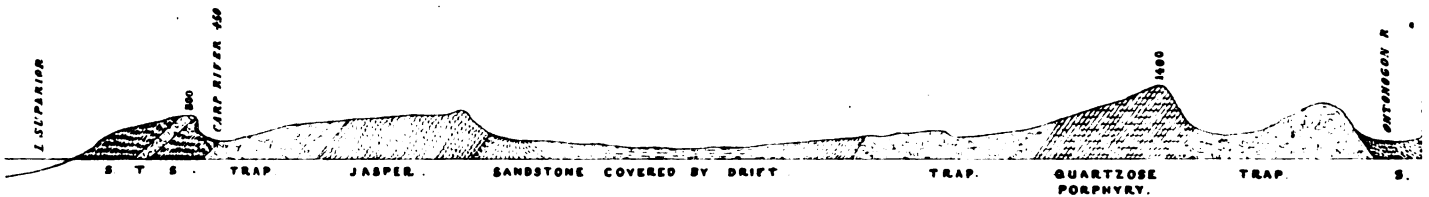


Fig. 16


L. SUPERIOR
800
CARP RIVER 450
1600
ONTONAGON R
S T S.
TRAP.
JASPER.
SANDSTONE COVERED BY DRIFT
TRAP.
QUARTZOSE PORPHYRY.
TRAP.
S.

BIRDS EYE VIEW OF COPPER HARBOUR.

Catalogue of mineral specimens—Continued.

No. of ecimen.	Between sections	Distance.	Description and remarks.
		Chs. *4ks.*	*Township 54 north, range 36 west.*
	3 & 4	51 00	Sandrock, red; coast.
	29 & 30	40 75	Sandrock, red; bed of stream.
			Township 55 north, range 36 west.
	24 & 25	20 00	Red sandrock; cliff 75 feet high, coast.
			Township 52 north, range 35 west.
	35 & 36	72 00	Brown sandrock; bank of stream; dip horizontal, course northeast and southwest.
	25 & 26	60 00	Red and gray sandrock; bed of stream; dip horizontal.
	26 & 35	.....	Red sandstone boulders; line.
	26 & 27	63 00	Red sandstone boulders; stream.
12	22 & 23	51 50	Sandrock, light red and gray, coarse; stream.
	3 & 4	20 00	Trap, (as supposed;) hill, course northeast and southwest.
	20 & 21	63 00	Trap boulders, quartz and amygdaloid; stream.
	17 & 20	45 00	Trap boulders; sides of deep valley.
	17 & 20	54 40	Trap boulders; stream.
	17 & 18	28 00	Trap and sandrock boulders; knob.
	8 & 17	26 00	Trap boulders, altered; stream.
			Township 53 north, range 35 west.
	25 & 26	79 00	Trap and primary boulders; bed of stream.
	22 & 24	1 00	Trap boulders; bed of stream, dry.
	13 & 24	71 00	Trap boulders; stream.
	26 & 27	32 00	Trap boulders; hill, east side.
	23 & 26	76 00	Trap boulders; dry bed of stream.
	33 & 34	44 75	Trap boulders; stream.
	33 & 34	57 49	Trap boulders; stream.
	27 & 34	63 00	Trap boulders; stream.
	21 & 22	59 80	Trap boulders, with native copper; stream.
	15 & 16	.....	Trap boulders and sandstone; entire line.
	15 & 16	14 00	Trap, in place; hill, north side.
	10 & 15	31 00	Trap boulders; stream.
	9 & 10	S. ½ of line	Trap boulders; level land.
	3 & 10	W. ½ of line	Trap boulders.
	32 & 33	20 00	Trap boulders; summit of range, 650 feet above Lake Superior.
	28 & 33	W. ½ of line	Trap boulders; highest point of range, 700 feet above Lake Superior.
	28 & 29	.....	Trap boulders; entire line.
	21 & 28	26 00	Trap boulders; dry bed of stream.
	20 & 21	25 00	Trap boulders; stream.
	20 & 21	67 42	Trap boulders.
	31 & 32	30 00	Trap, (supposed in place,) knobs.
	31 & 32	75 00	Trap, (supposed in place;) knobs.
	31 & 32	.....	Trap boulders; sides of knobs.
	29 & 32	8 00	Trap (supposed in place;) range of knobs east and west.
	29 & 32	22 00	Trap (supposed in place;) range of knobs northeast and southwest.
	20 & 29	38 00	Trap boulders; large, level.
	20 & 29	70 00	Trap boulders; dry bed of stream.
	19 & 30	69 00	Trap boulders; Elm river.
	17 & 20	66 10	Trap boulders; stream.

Catalogue of mineral specimens—Continued.

No. of specimen.	Between sections	Distance.	Description and remarks.
		Chs. lks.	
			Township 54 north, range 35 west.
			Hill in southeast corner of township, supposed to l trap; no rock seen.
			Township 55 north, range 35 west.
	2 & 3	20 00	Sandrock, coast; ledge 1 foot under shingle beach
	3 & 10	23 00	Sandrock, coast; ledge 1 foot.
	15 & 16	10 00	Sandrock and shale, coast; ledge 5 feet.
	9 & 16	9 00	Sandrock, coast; ledge 12 feet.
	20 & 21	32 00	Sandrock; stream over cliff of 50 feet.
	20 & 21	64 00	Sandrock, coast; ledge 20 feet.
	19 & 20	47 00	Sandrock, coast; ledge 75 feet.
			Township 53 north, range 34 west.
			Hills in northwest corner, supposed to be trap.
			Township 54 north, range 34 west.
	22 & 23	.....	Sandstone, white; beds of streams.
	10 & 15	34 00	Trap, small knob.

BELA HUBBARD,
Deputy Surveyor and Geolog

GEOLOGICAL REPORT OF BELA HUBBARD.

Report upon the geology and topography of the district on Lake Superior subdivided in 1846 *by William Ives, under the geological supervision of Bela Hubbard, with tabular statement of specimens collected.*

The district embraces the townships and fractional townships following, to wit:

Fractional township 49 north, range 25 west.
Fractional township 49 north, range 26 west.
Island in township 50 north, range 25 west.
Fractional township 50 north, range 26 west.
Fractional township 51 north, range 26 west.
Fractional township 51 north, range 27 west.
Township 51 north, range 28 west.
Township 51 north, range 29 west.
Township 51 north, range 30 west.
Township 51 north, range 31 west.
Fractional township 52 north, range 27 west.
Fractional township 52 north, range 28 west.
Fractional township 52 north, range 29 west.
Fractional township 52 north, range 30 west.
Fractional township 52 north, range 31 west.
Islands in township 53 north, range 29 west.
Fractional township 53 north, range 30 west.
Fractional township 53 north, range 31 west.

Topography and general features.

Sienitic country.—These townships embrace the northeasterly flank of an elevated and very broken country, known as the "Huron mountains." The tract thus characterized extends from the extreme south boundary of the survey, near the range line between townships 48 and 49, as far as Huron river, between ranges 29 and 30, averaging about the width of a township. This formation of granitic or sienitic rocks is first seen on the coast for about two miles below Presq'isle, and, with the exception of that point, it continues to form the coast as far up as Granite point, at which place red sandrock appears. From this point the primary rocks recede from the coast, with the exception of some outlying ranges at and near Garlic river, but preserve a general parallelism to it for the remainder of their extent northwesterly at a distance of from one to two and a half miles.

As seen from the lake, this country presents a succession of elevated and rounded hills of a rough and forbidding character. These vary much in height; but though presenting many apparently very lofty cones, the highest was not estimated to exceed 800 feet above Lake Superior, while their height above the country immediately surrounding varies from about 50 to 650 feet.

It is not easy, out of the apparent confusion, to find any general order of arrangement, which probably does not exist over a large portion of the district. There is, however, a double system discoverable in the direc-

tions of the ranges over a considerable part of the district, a correct idea of which may be had by observing the courses of the streams. The first is the general northwesterly and southeasterly direction common to the hills as part of the general range, across or at right angles to which the larger streams pursue their course to the lake. The other is shown in a series of shorter and broken ranges parallel to the courses of these streams, which traverse the larger valleys of the district between the latter ranges. Their direction is about NNE. and SSW., and they are seldom traceable more than two miles. These also are broken across by smaller streams and valleys which pass between a subordinate set of cross ridges that have the general direction of the district, but seldom exceed a mile in extent.

In general the summits of the hills present many bare surfaces of rock, and these, as is common in granitic countries, are rounded, as though water-worn. Their sides also, particularly on the south, and on the easterly and westerly ends of the smaller ridges, exhibit broken ledges and cliffs of rock, often perpendicular, usually from 5 to 20 feet in height. The frequency of these, and the constantly broken character of the surface, rendered the survey of this district a work of much difficulty and labor.

With these exceptions, the hills are covered with soil sufficiently deep to conceal the rock to great extent, and to support a growth of forest vegetation. The summits and elevated sides of the larger hills have a small and scattered growth of fir, spruce, sugar, white and yellow pine, black oak, &c.; while the less elevated parts of the country, and the valley portions, are densely clothed with hemlock, sugar, birch, and fir, generally of large size; sugar maple frequently predominates over the more trappose portions of the district. The richer portions have also some lynn; and large white pines, cedar, tamarack, spruce, alder, and black ash are found along the streams and in wet ground.

The soil of the hilly region is composed chiefly of the disintegrated rocks of the country, and in part of sand drift, and, like most granitic soils, is often quartzose and poor; it may be denominated in general second rate. It will be seen, however, from the description which will follow of the character and variety of the rocks, that the elements of a good soil are far from being wanting; indeed, that from the very large proportion, in many places, of trap and hornblende rocks, we might expect to find, over considerable portions of the district, a soil of much more than the ordinary fertility of granitic countries.

Sandrock country.

Descending from the hilly country towards the lake, over the portion occupied by the red sandrock, we find a gently rolling surface, densely timbered with hemlock, yellow birch, sugar, fir, cedar, and yellow pine. The soil is sandy, being composed, in great part, of the underlying rock, and is in every part much filled with its undecomposed fragments; it may be denominated poor second-rate. Marshes of from a few acres to a mile in extent are of occasional occurrence, and plains of equal extent occur covered with spruce or Norway pines.

Clay slate country.

The remaining portion of the surveyed district, occupied by township 51 N., ranges 30 and 31, and the west part of 29, which are mostly underlaid by the clay slate formation, have a gently rolling surface, descending from an elevated plateau, or table land, in the latter township, which is estimated to be the highest land in the district, and 850 feet above Lake Superior.

Throughout this region the depth of the soil is irregular, rock only occasionally approaching the surface, or being discovered only in the principal streams. It is generally a sandy loam, sometimes inclining to clay, and occasionally, though rarely, a stiff clay loam; it may be denominated throughout good second-rate. It is composed of mixed debris of the sand and slate rocks, with a small portion of trap—a combination well calculated, in connexion with the surface characteristics, to produce a good agricultural district. The growth of timber is thrifty, consisting of sugar, yellow birch, hemlock, fir, ironwood, lynn, cedar, spruce, aspen, maple, alder, and hazel; the first three predominating. On the clay portions, good wild grass grows luxuriantly in the open and wet places.

Water and streams.

Throughout the entire district water is sufficiently abundant, but the streams are in general, particularly in the sienitic region, small and rapid. In ranges 28 and 29, townships 51 and 52, and occasionally elsewhere, are very considerable lakes. The general abundance of water power, and the several varieties of pine and other valuable timber in many parts of the sienite and sandrock portions of the district, will afford good advantages for lumbering.

Granites and sienites.

It will be observed that the metamorphic rocks described in the report upon the geology of the surveys of 1845, in their approach to the granulitic country lying northerly, assume more of a trappose and less of a slaty character. Although this change is gradual, the rocks of the townships bordering the present survey are very distinctly granitoidal, the metamorphic rocks being much decreased in relative proportion. A feature peculiar to all the rocks of the country alluded to as granitic, is their occasional trappose character, and the rare occurrence of mica. The constituents which make up the greater part are quartz, felspar, and hornblende; the proportions of which vary extremely. Thus, while the general character is that of true *sienite*, the absence of quartz in a distinct form often produces a *greenstone*, while frequently the last mentioned mineral predominates almost exclusively, constituting a true *hornblende rock*, which is generally of a crystalline structure, and usually has a slaty cleavage. Again, quartz becomes the predominant mineral, constituting what may be denominated a *quartzite*. Very generally, indeed, these sienites are either made up chiefly of quartz and felspar, with hornblende in very small proportion, or else the latter assumes so large a proportion as to give the character of hornblende rock. A true greenstone occurs only in the townships bordering the surveys of 1845, or in the trap dikes,

which are numerous. In a few instances talc was found to take the place of hornblende, constituting a *protogine.*

The prevailing character of the rock is that of a *fine grained sienite,* varying in color from a light to a dark reddish gray. The hornblende grains are frequently arranged in planes, giving a gneissoidal structure to the mass, and an appearance of stratification. This appearance is very general and uniform over large portions of the district, and the planes have a very persistent and uniform dip. These are sometimes, though not always, identical with the planes of cleavage. The general direction of their dip varies from N. to NE., and from 30° to 80° in amount. This gneissoidal character is more particularly observable in the sienites of ranges 27, 28, and 29.

It will be seen by the maps that a range of hills commences near where the south boundary of township 49—25 strikes the coast, and runs for several miles in close proximity to it—rising in one instance to the height (as determined by triangulation) of 470 feet. In the same range may be included Middle island and the several smaller neighboring isles, and Granite point. After an intervening space of about five miles of level country occupied by the sandrock, the range is again seen pursuing the same northwesterly direction along the coast as far as Garlic river, in township 50—26. Following the same direction, a small protrusion of granite rocks is seen in a projecting point in township 51—26; another from beneath a high cliff of sandrock, where the northern boundary of township 51—27 reaches the lake, beyond which this rock is no more seen upon the coast, but appears to terminate in the Huron isles, about three miles distant from it. Southwesterly several knobs of sienite protrude through the sandrock in the vicinity of Huron bay, at several miles distant from the main body. Eastwardly several miles beyond the ranges, a single protrusion of sienite makes its appearance as an island in the lake. The rock of much of this outer portion of the granitic district is of a peculiar character, consisting of mixed sienite and hornblende rocks, frequently approaching the character of hornblende schist, and often exhibiting beautifully variegated and blended colors. The rock of the Huron isles is in the main a fine-grained sienite of light gray color—mica being rare, except in the numerous granitic veins by which the rock is traversed irregularly. It rises in knobs to the height of from 100 to 250 feet, and is cut by several very large dikes of trap. The rock is also traversed by splits or joints, so numerous and regular as to separate the entire mass into blocks or upright prisms, nearly rectangular, of from six inches to two feet in thickness, and from two to fifty feet in vertical length, and varying in width from six inches to four feet. The directions of these uplifts vary many degrees; but, taking an average of the observations, there would seem to be two principal sets, having directions N. 75° E. and N. 30° W., and being nearly vertical, though frequently inclining from 1° to 10° from a perpendicular. The third set of splits by which the rock becomes separated into prisms, is of much more rare occurrence. They are nearly horizontal, having only a slight dip easterly, not exceeding 10°, but sufficiently apparent to occasion a general slope to the mass in that direction. The assistance afforded by these joints will render very easy the labor of quarrying into blocks of almost any required dimensions, and the material is hard and durable.

At the eastern end of these islands, the rock assumes the mixed char-

acter first mentioned; which character continues to possess most of the rocks of the range alluded to as far as Middle island. The southerly half of this island, as well as the neighboring coast, is composed of the fine-grained gray sienite already described, while the northerly portion, together with the rocks of Granite point, and the coast thence to Garlic river, are of the first mentioned description. This character is given in part by the separation and aggregation of the different mineral constituents into distinct portions of the mass, variously arranged. These are frequently made up of well-defined stripes or bands, traversing the rock both in vertical and inclined planes, and composed of the differently constituted parts. Those composed of hornblende are mostly of black or very dark color, the siehitic and quartzose being of various shades of red, green, white, and yellow, while many of the green stripes are probably due to pyroxene, augite, and actynolite, the latter sometimes exhibiting the light green crystals of the glassy variety. These stripes vary in width from a mere line to several feet. They sometimes possess much regularity of direction, but are often waved. In many places the several parts are segregated into irregular patches, which often graduate into each other, giving the whole rock a mottled appearance. This variegated character is increased by numerous veins, mostly of quartz and felspar, varying in width from a line to two feet, and which traverse the mass without any regularity.

The schistose character of much of this rock will impair its usefulness as a building-material, though a great part is quite compact. It is cut by joints or splits, the most numerous of which have N. and S., and E. and W. directions, and are generally vertical. Another set, nearly horizontal, divides the mass into blocks of nearly rectangular form, and of convenient size for quarrying. Many portions of this rock, were it susceptible of equal polish, would not yield in beauty to the finest variegated marbles. It will not be thought that we overestimate the importance of this material for purposes of construction, when it is considered that its superior beauty and permanency give it a value that belongs to none of the rocks which compose the great secondary region of the United States, and that so soon as the obstruction of the St. Mary's rapids is overcome, it will, notwithstanding the distance, be accessible by water transportation to all parts of the Mississippi valley.

Trap rocks.

We have already alluded to the trappean character of much of the sienitic rocks, and to their frequent passage into pure hornblende. The indications of the near approach of trap to the surface are very evident throughout the whole district; and the almost entire absence of mica from the primary formations, seems to indicate the existence of those conditions which are required for that class of rocks into which hornblende enters so largely. We accordingly find the sienites assuming a trappose character, and often undergoing so insensibly the change from a granitic to trappean rock, that it is impossible to distinguish where one begins and the other ends. In the operation of these changes, the excess of silica may be called in to account for the metamorphic rocks of the country, and particularly for the abundance of pure quartz in rocks and veins. This gradual passage of one rock into the other is exemplified in that

portion of townships 49, 26, which is designated on the maps as consisting of trappose and hornblende rocks; a considerable portion of these retaining somewhat of their sienitic character.

Every part of the sienitic region is cut by dikes of compact and greenstone trap—these being sometimes met with as often as once in every eight chains, and varying in width from 1 to 100 feet. The position of these is nearly vertical, and they almost invariably preserve a zigzag course, though having a uniform general direction. No uniform magnetic bearing was discoverable; but the greater proportion of the larger dikes have a direction varying but a few degrees from north and south, crossed by others at right-angles to that direction. The material of these dikes is usually of a compact homogeneous texture, sometimes approaching greenstone or rock in which hornblende and felspar are aggregated into somewhat distinct crystals. Sometimes the material of the dike approaches the character of slaty augite. In a single instance was observed in the sienitic rocks near Garlic river a dike of porphyritic hornblende several feet in width.

The trap of all the dikes has a very distinctly jointed structure, being cleaved into oblique angled prisms, from a few inches to several feet in thickness, the longest sides being across the dike at right-angles to its length.

All these dikes appear to belong to an era prior to the deposition of the sandrock, for in no instance was the latter observed to be traversed by them.

Metamorphic rocks.

It will be observed that the ordinary succession of the rocks of the primary formations is nowhere fully carried out in this district. The absence of mica, in any considerable proportion, occasions the mica-schists to be wholly wanting; nor is there any true gneiss, except in exceedingly limited areas. The argillites are, however, largely developed, and there is a degree of metamorphism frequently observable, more particularly in connexion with the sienites and hornblende rocks of the easterly extent of the primary district, and wherever the latter assume a trappose character.

In township 49 north, ranges 25 and 26 west, are several occurrences, over quite limited areas, of rocks partaking apparently of an altered nature; consisting of metamorphic quartz, with talcose and chloritic slaty rock. These occupy basins surrounded by the trappose or sienitic rocks of the country.

Considerable changes have also taken place at the immediate junction of the slate and sandrocks with trap or trappean rock, which are matter of much scientific interest. The passage of a trap dike has almost invariably produced changes in the character and structure of the containing rock, and similar changes are observable in the clay slates wherever a knob of trappose rock has protruded. In these cases the containing rock is usually much hardened, and its crystalline structure also undergoes corresponding change. But not only have changes accompanied the contact of trap with other rocks, such as have usually been referred to the heat of the injected mass when in a state of fusion, but equally marked changes have accompanied the conjunction of the *sienites* with the sandrock under

circumstances where the same causes cannot be called in; for the latter gives evidence of having been deposited subsequently to the formation and uplift of the former, and the sienite was as often observed to have partaken of the change as the sedimentary rock. Without going further into detail of facts of merely scientific nature, it may be sufficient to say that it seems more reasonable to attribute the metamorphism which has taken place in both rocks rather to galvanic and chemical action than to igneous causes, which are so generally called in to account for all these phenomena.

The rocks designated upon the maps as metamorphic, occupy, as it were, beds amid the surrounding primary rocks; and while we would avoid any theoretic conclusions as to their origin, it may be stated that, throughout the whole primary region, the limits of each rock, except in the case of dikes, are seldom distinctly defined, but one passes into the other by gradual transition; so that often rocks of distinct name and character can be considered only as members of the same formation, the constituents of which have become differently aggregated.

Argillites.

The small tract of argillitic or clay slate alluded to in the report of last year is included, to a very small extent, within the limits of the present survey, but a tract of much more considerable extent occupies a large portion of the present district, west of the sienitic ranges, the extent of which has been already described under the remarks upon the topography of the district. This rock appears under several varieties, embracing considerable beds of novaculite, or hone-slate. It is in general characterized as a soft, fine grained argillaceous slate, varying in color from light gray to black. It lies in strata of varying thickness, from a few inches to three feet, the average being probably about ten inches. These have a very apparent general dip south-southwesterly, varying in amount from 10° to 45°. Both direction and amount of dip are irregular, being, no doubt, influenced to great extent by the uplift of the trap rocks, which protrude frequently.

All these slates, except where altered by the proximity of trap, have a very distinct cleavage into thin lamina from one-sixteenth of an inch to one inch in thickness. These very rarely conform in the direction of their dip to that of the strata, and are generally more in amount. The average may be considered as southerly or SSW., and the amount varies from 45° to 70°. The strata are frequently marked by parallel stripes of a lighter color, and, as these correspond to the lines of stratification, the angles between the planes of stratification and cleavage may be readily observed in several of the hard specimens.

Besides these planes of stratification and cleavage, the mass is traversed by joints or splits nearly vertical at the distance of from a few inches to two feet, and occasionally three or four feet apart. Their courses are in general about N. 20° E. and S. 20° W., but varying, and may be considered as having an average but little east of the meridian. The slates are thus divided into oblique prisms, having two of the lateral planes relatively large to the others, and may be quarried with much ease. Some of them would answer a good purpose for *roofing:* as also for school-slates and pencils, portions being very fine, soft, and free from grit. Con-

siderable portions of the rock approach *novaculite*, or hone-slate, being very fine-grained and of varying hardness. These are usually of a light yellowish or brown color. They sometimes assume a talcose or steatitic appearance, and portions of the true slate are traversed by veins or segregated masses having the same character.

If we assume the dip of this rock as above mentioned to be uniform throughout the district, it would give a thickness to the slates of not less than 15,800 feet, or about three miles. Where this rock makes its appearance on the coast of Keweenaw bay, at L'Anse, the sandrock is seen to rest unconformably upon it, dipping slightly northeasterly, while the clay slate and novaculite dip southwesterly about 45°, conformably to the general dip as seen throughout the district. It is, however, to be observed that the dip is in many places much contorted, and sometimes thrown into an opposite direction by the protrusion or approach of the underlying igneous rocks; so that it is probable this apparent thickness is deceptive.

Throughout the slate district occasional knobs of well-defined greenstone trap are met with, which are of small extent, and rise but a few feet above the general surface. The occurrence of these seems to render it evident that the slates are entirely underlaid at no great depth by the trap and granite rocks, and may be conceived to have originally occupied a portion of the basin lying beyond the main primary ranges, the present inclination of the strata having been given by the uplift and protrusion of the underlying igneous rocks previous to the deposition of the red sandrock. The source and connexion of these trap uplifts will be better understood when we observe the great extent of greenstone and hornblende rocks lying immediately south, as defined by the town-line surveys of the past season. This district of trappose rocks bounds the slates along nearly their whole southern margin, and embraces from 4 to 5 sections of township 51 north, ranges 30 and 31, within the present survey.

Sandrock.

The description given of this formation in previous reports will apply to the present district in general. The formation occupies all that part of the district lying outwardly from the granitic country and the slates, and constitutes the cliff portions of the coast, with the exception of the portions formed by the outer granitic ranges. These cliffs vary much in altitude, and rise in some instances to the estimated height of 70 feet. They consist of strata varying in thickness from one to five feet, and nearly horizontal. The upper strata, which are often of light gray color, are the thickest; the lower strata, which have a light red or brownish red color, with circular spots of gray, as well as the elementary layers or laminæ, seldom exceeding half an inch to one inch in thickness. The latter, which may be considered as coincident with the planes of cleavage, are frequently inclined at various angles to the general plane of the stratification, and are sometimes waving. Though apparently horizontal, repeated observations show a slight dip to the sandrock strata outwardly in all directions from the granitic country which composes its base. The sandrock, in fact, lies in a basin formed out of the rocks, and appears to have partaken of no disturbance since its deposition—at least, which has not been general to both rocks as a mass. The strata exhibit

at their junction with the sienites but little greater inclination than is common to them elsewhere—in no instance exceeding 15°, which is not the case at their junction with the trap—a circumstance which has some bearing upon our views of the metamorphism of the rocks at these points. The sandrock is supposed not to attain an elevation exceeding 200 feet above Lake Superior.

Besides the lines of lamination and stratification, the sandrock is cut by numerous joints, which pass across the strata at angles varying from 1° to 30° from a perpendicular, and having a general north and south direction; these are crossed by others nearly perpendicular, and which make with the former an angle of about 50°. As the rock cleaves most readily in the direction of these joints, the cliffs present often smooth and perpendicular faces of many feet extent. Along the cliffs these joints are seen to form large and quite uniform fissures. These sometimes contain several minerals, and will be alluded to again in our separate remarks upon the minerals of the district.

But little of this rock, it is probable, will prove sufficiently durable for purposes of building.

Minerals and veins.

The minerals found most abundant in the sienitic region, are quartz, under the varieties called hyaline, greasy and milky; felspar, in several varieties, generally inclining to red; hornblende, graduating into augite, actynolite, tremolite, and asbestos; tourmaline; prehnite; iron, sulphurets and oxides; copper, pyrites and gray sulphuret; and galena.

Besides these, were found associated with the metamorphic rocks of the district, steatite, novaculite, chlorite, talc, and calc spar.

In the slate rocks, quartz and iron pyrites are the most abundant minerals, and almost the only ones noticed, except in connexion with the knobs of trap.

In the sandrock were found calc spar, carbonate and gray sulphuret of copper, sulphuret of lead, and oxide of iron.

It has been already observed that veins of granite and quartz are very abundant in the sienite. These may all be considered as belonging to the class of *contemporaneous veins*, and are irregular in size and direction, apparently in this respect conforming to no general law, and varying in width from a small fraction of an inch to several feet. In a single instance a vein of quartz was noticed with a width of 10 feet, though very few exceed two or three feet.

These veins are frequently composed of a true granite, the only mica through large districts being that found associated with the quartz and felspar in the veins. The two latter minerals, however, always predominate, the felspar being often in large and distinct crystals, of from one to six inches in length.

In general these veins are very distinctly marked, and do not graduate into the enclosing rock, though they often bifuscate and swell out so frequently, and to such extent, that it is difficult to distinguish their true character.

It has been noticed that the entire mass of the sienitic rocks is traversed by lines of fracture or *joints*, separating the rock into blocks. These sometimes cut the veins alike with the containing rock, without shift or

dislocation; at other times the veins are stopped by the joints; at others, the joints by the veins. Sometimes for considerable distances the joints conform in direction to the veins, and in a few instances each appears to have shifted the other. Occasionally was observed an apparent *dike* of true granite, and one of these of 28 inches width, accompanied by a narrow dike of slaty hornblende, was seen to have cut and shifted a vein of reddish felspathic granite of eight inches width for the distance of two feet. In townships 51, 27, some veins were noticed having the character of a dark compact greenstone trap.

In the class of sienitic hornblende rocks alluded to as constituting the outer range which appears on the coast, the irregular segregated masses of sienite and hornblende are frequently separated by veins of true granite, like those above described, and sometimes by what may also be considered as veins of hornblende. In fact, the more distinctly sienitic portions of the mass are traversed by veins of the latter character; while the hornblendic portions are not only traversed by true granite veins, but curiously and irregularly mottled with patches, variously colored, according to the excess of one or other constituent, and giving the whole mass the mottled appearance already alluded to in the description of the sienitic rocks.

No portion of the sienitic country included within the present survey can be said to be metalliferous. The prevailing mineral is undoubtedly *iron*, which is largely diffused in both a free and combined state throughout all the rocks of the district. It was occasionally noticed as a coating of dark yellow oxide associated with the quartz of the veins, and more frequently as a yellow sulphuret or iron pyrites, more particularly in the hornblendic portions of the rocks, and in most of the trap dikes. It generally occurs in minute particles and crystals.

The yellow sulphurets of copper and iron were discovered in a very few instances associated with asbestiform and steatite rock, composing an imperfect veinstone along the walls of trap dikes. These metals were more immediately associated with irregular bunches of calc spar and quartz, but also pervaded the talcose mineral. Some of the hard specimens, it will be observed, have a considerable "show" of mineral, but these veins were not regarded as of much, if any, practical importance. In another and single instance there was found associated with quartz of the veins in the sienite, an unusually compact gray sulphuret of copper.

Although so few minerals of known importance to the miner were discovered, and these in small quantity, it must be borne in mind that both the character of the country and the extent and nature of the survey were such as to accomplish general purposes mainly; and while the observations made would lead us to the conclusion that the rocks of the country may be considered as "dry" in regard to the more important of the metals which are usually associated with granitic rocks, they can by no means be considered as conclusive of the entire absence of such minerals. Most of the ores which are found accompanying true granites are more or less associated with the sienites, but in general the latter rock is considered not to afford a good base for metals.

It has been stated that the sandrock, alike with the other rocks, is traversed by joints and seams. Some of these are sufficiently open to admit the finger, and may be seen to extend from top to bottom of the cliffs which appear along the coast, and are generally inclined from a vertical,

ɔ to 30°. These have the character of faults, for sometimes, where two proach each other within a few feet, a *throw* has taken place, by which ɛ strata of the included portion, and in some instances the strata adning, for a few feet, have become inclined from the general direction, an angle of several degrees. Many of these seams are sufficiently open have admitted the collection of various earthy and mineral matters, hich have the character of a veinstone, and have been an inducement several mining companies to commence the operation of drifting. The rgest of these crevices was about three inches wide, and filled in part ith soft, partially decomposed sandstone, and in part with calc spar, sociated with the sulphurets of lead and copper. The latter minerals mpose but a small part of the contents of the fissure, and seldom exceed lf an inch in thickness. Though to some extent carrying ore, these ssures have none of the characteristics of true veins, and a little observaɔn might have convinced those engaged of the futility of expectations ıat they would prove to be leaders to large veins; for, aside from their ue character as above explained, it would have been seen that the eleıents themselves have been long and incessantly conducting the process f mining by the rapid wasting away and retreat of the soft rock of the liff, and yet at no point have they exposed any portion containing ore ıfficiently abundant and rich to be worth the cost of obtaining.

No true metalliferous veins were observed in the slate rocks, though ıany of the veins of quartz are occasionally colored by an oxide of iron, nd the rock contains abundance of iron pyrites. The latter mineral exɪts in cubic crystals pervading the mass.

Iron, though by far the most abundant and generally diffused mineral ıroughout all the rocks of the district, nowhere appears segregated into eds of the extent and character of those found further south, and which ere described in the report upon the surveys of last season.

Magnetism of the trap rocks.

It was observed in the report accompanying the return of subdivisional ırveys of last year in the mineral region, that the needle was so freıently influenced by causes which tended to interrupt and vary the ornary tendency of the earth's magnetism, as to render the use of Burt's lar compass absolutely indispensable. Similar causes have operated in ɛe manner throughout almost the entire portion of the district now under view.

These local deviations, it is probable, are sometimes due to galvanic or ectrical currents, produced by the contact of rocks of different electrical finities, aided probably by secondary, and perhaps temporary causes, ıch as changes of temperature and moisture.

A still more important cause of these variations is the magnetic charter of the trap rocks. This influence is frequently observable as an fect of the rock in mass; but in some instances portions of the trap kes were found to possess a high degree of magnetic polarity, and to use powerful, though strictly local, effect upon the needle. This ıenomena is apparently of rare occurrence, and was observed only in nnexion with the dikes of the more southeasterly portion of the sienitic strict. It is to be observed, however, that in these instances the effect oduced upon the needle at the ordinary height above the dikes of the

surveyor's compass, was rarely greater than in those cases where the magnetic influence was diffused through the mass, or attributable to a different source, and in no instance is a greater variation than 40° noted in the linear surveys, and it rarely exceeds 6°—varying generally from 4° 40′ to 5° 40′.

A series of observations, however, proved that, with some of the dikes, the effect upon the needle was in the same ratio of its approach to the rock, as in the case of an artificial magnet. In fact, portions of the dike were found to be possessed of polarity; even small hand specimens in some cases proving to be magnets of much power. The best loadstones were obtained from a dike of granular greenstone on Middle island, of a dark gray color, and exhibiting no difference discoverable to the eye from those parts of the same dike which possessed no polarity. Occasional particles of iron pyrites, common to nearly all the trap of the dikes, and a little yellow sulphuret of copper, were the only metallic minerals not directly in combination with the rocky matter. The course of this dike is east and west.

The experiments made, seem to warrant the conclusion that the magnetic portions of these dikes compose a series of magnets, acting independently of each other, and irregularly disposed through a mass of magnetic trap. The directions of the north poles of these separate magnets vary as far as 90° to either side of a meridional, and perhaps the average may be considered as meridional. The inclinations of the poles to the horizon also make various angles, 70° being the highest observed.

A limited number of observations were attempted in several parts of the mineral region, as well as at points intermediate between that country and Detroit, with a view to determine the dip and intensity of the magnetic needle; but as it was found impossible to obtain any instruments more accurate than horizontal and dipping needles of the most simple construction, but little was accomplished. The results obtained, however, seem to establish a connexion between the immense formation of trappose rocks upon Lake Superior, and the variations in the direction, dip, and intensity of the magnetic needle, which is manifest probably over an extent of country many miles beyond the limit of the actual protrusion of trap. This subject may also assume an increased importance from the intimate connexion of veins of copper and other ores with the trap rocks, and, as is further probable, with some of the developments of magnetic action. Much is to be hoped from the more extended observations of such men as Dr. Locke, in multiplying facts upon a subject now so little understood, but pregnant with important results, and much, especially, from the numerous and systematic observations which are required under the present enlightened system of the United States surveys of the mineral region.

Ancient lake ridge.

In coasting along the sandrock portions of the lake coast, very considerable and sudden variations are observable in the height of the cliffs; the latter being frequently seen to rise, by a sudden though regular curve of about 45°, from the height of 10 or 15 feet to that of from 40 to 80 feet. Passing inland, it is observable that these elevated cliffs are part of the more upland portions of the sandrock country, the descent from

which is almost invariably by a similar curve to a plane 10 to 30 feet below. These ridges, without doubt, once constituted the shores of the lake at an era when its waters were stationary for a very considerable period, at an elevation of about 25 or 30 feet above their present level. The form which this ancient coast possessed is represented upon the geological map accompanying this report, and serves also the further purpose of establishing an *isometrical line* throughout the surveyed district, having the height above assumed for the ancient lake level. Its greatest distance inland from the present coast is about 2½ miles.

Similar evidences of the same phenomena are observable throughout the whole southern coast of the lake westerly, while at the Pictured rocks, a little interiorly from the coast, may be seen at the same height isolated cliffs, exhibiting deep cavernous fissures, worn by the waters in a manner similar to those which are now exposed to the incessant action of the waves along that wonderfully singular and picturesque portion of the lake coast.

Without entering into any merely speculative considerations, it will be sufficient to add that these facts are of interest, as evincing that the cause which produced this variation of level was general and uniform throughout the whole length of the lake coast, and that no great disturbances by the upheaval of extensive isolated districts have taken place since that period. They thus conduct us to an epoch which, though it be not a fixed and certain point of time, is yet of equal importance with eras in history, in enabling the geologist to estimate the progress of changes, and arrive at a more accurate history of geological events.

In addition to the geological map and catalogue of specimens, two sections are herewith returned.

BELA HUBBARD,
Deputy Surveyor and Geologist.

DETROIT, *January* 1, 1847.

Catalogue of geological specimens collected in Hubbard and Ives's district of public surveys, 1846.

No. of specimen.	Between sections	
		Township 49 north, range 25 west.
1	31, 32	Sienitic granite, fine grained, grayish red.
2	31, 32	Greenstone trap, compact; dark green; fracture conchoidal; dike.
3	31, 32	Sienitic granite, fine grained, grayish red, in one, three, and four proportions of hornblende, small and of greenish color.
4	30, 31	Sienitic granite, coarser grained, red.
5	30, 31	Sienite, gray.
6	29, 30	Sienite, fine grained.
7	29, 30	Sienite, coarser grained, protogine? A talcose mineral seems substituted for hornblende.
8	19, 30	Greenstone trap, dark greenish, with iron pyrites. } Supposed
9	19, 30	Greenstone trap, dark greenish, with reddish spots. } dike.
10	19, 30	Greenstone trap, very compact, with specks of iron pyrites, fracture conchoidal. Rock containing above dike.
11	19, 30	Steatitic rock, with some mica; fracture irregular.
12	19, 30	Protogine. (?)
13	19, 30	Metamorphic, granitic gray.
14	19, 30	Sienitic granite.
15	32, 33	Sienitic gneissoid.
16	32, 33	Sienitic gneissoid.
17	32, 33	Greenstone trap, compact, black. } Dike 40 feet wide; course northwest; var. at middle 18° east.
18	32, 33	Greenstone trap, granular, yellow black. }
19	32, 33	Sienitic granite, red, fine-grained; rock including above dike; var. 3 chs. south, 7 deg. 24 min.; at 6 chs. north, north 5 deg. 10 min.
20	29, 32	Sienitic granite, mixed red and gray, fine grained.
21	19	Trap, very compact, black. } Dike 20 feet, course east and
22	Shore of lake	Greenstone trap, granular, dark. } west; vertical.
23		Greenstone trap, compact, dark. }
24	19	Sienite, red and gray; proportions of hornblende larger than usual; rock containing dike, 21, 22, 23.
25	Shore of small	Sienite, red and gray; proportion somewhat gneissoid.
26	lake.	
27	.....do.....	Sienitic hornblende, greenish, and separate from the quartz and felspar.
28	Middle island..	Red sandstone, very coarse grained.
29	.....do.....	Red sandstone, coarse
30	.....do.....	Red sandstone, metamorphosed, grayish red.
31	.....do.....	Steatitic, (?) with grains of quartz, light green, soft.
32	.....do.....	Steatitic, grayish; 31 and 32 lie below 30; undoubtedly metamorphic.
33	.....do.....	Metamorphic, mostly silex, grayish white, with some greenish *shorlean* mineral.
34	.....do.....	Steatitic, trappose, dark gray, soft; metamorphic. (?)
35	.....do.....	Hyaline quartz.
36	.....do....	Calcareous spar, with augitic rock; from vein 15 inches wide; course north, 43 deg. west; dip southwest, 80 deg.
37		
38	.....do.....	Hornblende, granular, greenish; general specimen.
39	.....do.....	Felspar, in small crystals, resembling granite, red and grayish; small veins in 38, numerous; no regular direction; 1 inch or more.
40	.....do.....	Quartzose rock, hard, dark reddish gray.
41	.....do.....	Serpentine, with trappose rock. Vein in trap dike; the latter 1 foot wide.
42	.....do.....	Greenstone trap, compact, very dark; dike, 5 feet; course east and west, zigzag. Dip vertical, cut by joints into rectangular blocks.

Catalogue of geological specimens—Continued.

No. of specimen.	On sections	
43	Middle island.	Talc, asbestiform.
44	.....do.....	
45	.....do.....	Steatitic, sub-talcose rock.
46	.....do.....	Steatitic (?) talcose.
47	.....do.....	Tourmaline, with asbestos.
		Vein in 48, 2 to 6 inches wide; course south, 50 east.
48	.....do.....	Hornblendic trap, with iron pyrites.
49	.....do.....	Slaty talcose rock, black, fissite, vein course north, 60 west.
50	.....do.....	Greenstone trap, dike 3 feet; course east and west. Dip, north 70 deg. in 51.
51	.....do.....	Quartzose rock; hard trappose, (?) containing dike, 50.
52	.....do.....	Quartz, with chlorite.
53	.....do.....	Chloritic rock.
		Containing copper pyrites; vein in 54; course east and west; dip vertical.
54	.....do.....	Chloritic, with copper (?) pyrites; dike 6 feet; var. 40 to 50 deg. west.
55	.....do.....	Trap, compact, *black*, fracture irregular; dike 1 foot; cutting dike of 4 feet at right-angles; course of latter north and south; dip vertical and zigzag, with vein like 52 and 53, several inches wide.
56	.....do.....	Greenstone, granular; dike 50 feet; course south 80 deg. east; dip vertical.
57	.....do.....	Metamorphic rock, sandstone (?) dark grayish; general specimen.
58	34	Trappose sienitic granite.
59	Lake-meanders 33.	Green quartzite; light green, with copper pyrites, and carbonate and silicate (?) of copper.
60	.....do.....	Steatite, with hard quartzose (?) mineral.
61	..... do.....	Hyaline quartz; in 62, 2 feet; course south 80 deg. east.
		Vein.
62	.....do.....	Sienitic granite, dark gray, containing vein 59, 60, 61.
63	.....do.....	Greenstone trap, compact, fracture conchoidal, dike 7 feet; course north 45 deg. east; irregular.
64	.....do.....	Sienitic granite, mixed, red and dark gray; dike (?) 10 feet; course south 60 deg. east; dip 75 deg. north, 30 deg. east.
65	.....do.....	Trap or metamorphic, dark gray; fracture irregular; conchoidal, dike curved.
66	.....do.....	Calcareous spar, with iron pyrites in crystalline dike, 2 feet; course north and south.
67	.....do.....	Trap, compact, *dark;* dike 2 feet; dip 30 degrees; course irregular?
68	.....do.....	Sienitic granite.
69	.....do.....	Hornblendic trap, *dark;* dike 30 feet; course west; dip vertical.
70	.....do.....	Steatite, dark green; vein 8 inches in 71; course west, in granite (?)
71	.....do.....	Sienitic granite, reddish.
72	.....do.....	Greenstone trap; dike 60 feet; course north 80 deg. west; dip vertical.
73	.....do.....	Quartz, with steatite
74	.....do.....	Chloritic slate.
		Vein 1 foot on north side of dike 72; course and dip same as dike.
75	.....do.....	Greenstone trap, compact, greenish black; dike 2 feet wide; dip vertical; cut at right-angles by large dike 72.
76	.....do.....	Sienite, with some serpentine; rock traversed by dikes 72 and 75.
77	.....do.....	Trap, compact black; dike 6 feet; course east and west; dip vertical; resembles dike 42 on north end of Middle island.
78	.....do.....	Greenstone trap, semi-crystalline, dark; dike 60 feet; course north 80 deg. west; dip vertical.
79	.....do.....	Trap, compact, *dark;* dike 28 feet; course north 82 deg. west; dip vertical; north side of ditto, variation 3 deg. 25 min.
80	.....do.....	Trap, compact, dark reddish gray; dike 40 feet; course north and south; dip vertical.
81	32	Trap, with film of steatite; dike 25 feet; course south 5 deg. west; dip vertical.
82	32	Greenstone trap, dark green; dike 18 feet; course west; dip vertical.
83	32	Sienite, grayish; general specimen.
84	29	Same as 80; dike 36 feet; course south 4 deg. east; dip vertical.
85	29	Same as 80; dike 75 feet; course north 80 deg. west; dip vertical.

Catalog

No. of specimen.	Between sections
86	29
87	29
88	29
89	29
90	29
91	29
92	20
93	20
94	17
95	Granite point.
96	.....do.....
97	.....do.....
98	.....do.....
99	.....do.....
100	.....do.....
101	.....do.....
102	.....do.....
103	.....do.....
104	.....do.....
105	.....do.....
106	.....do.....
1	35, 36
2	25, 36
3	25, 36
4	25, 26
5	35, 36
6	34, 35
7	34, 35
8	26, 35
9	26, 35
10	26, 27
11	26, 27
12	26, 27
13	23, 26
14	23, 26
15	22, 23
16	22, 23
17	22, 23
18	22, 23
19	33, 34

Catalogue of geological specimens—Continued.

No. of specimen.	Between sections	
20	33, 34	Hornblende trap, fine grained, dark gray; fracture irregular, associated with felspar and quartz, in small quantity.
21	33, 34	Sienite, gray; the hornblende sub-separate; hill 100 feet.
22	27, 34	Sienitic granite, light gray, fine grained; constituents appear blended.
23	27, 28	(Lost.)
24	27, 28	Same as 11; small knob.
25	27, 28	Same as 1; broad granite ridge.
26	22, 27	Sienitic granite, fine grained; light reddish gray, sub-gneissoid, broad granite ridge, north slope.
27	22, 27	Sienitic granite; light reddish gray.
28	22, 27	Sienitic granite; felspar being nearly white.
29	21, 22	Same 1; south side of ravine.
30	21, 22	Hornblende, fine grained, dark greenish gray; sub-crystalline, fracture irregular, conchoidal; hill summit.
31	21, 22	Same as 20; hill 550 feet, summit bare and smooth.
32	21, 22	Same as 30; block on hill side.
33	15, 22	Same as 1; cliff north side.
34	15, 22	Greenstone trap, *dark* granular.
35	15, 22	Greenstone trap, dark reddish brown; felspar reddish; cliff faces east.
36	15, 22	Greenstone trap, dark gray; granular (2 specimens;) cliff; dike?
37	15, 16	Same as 1; cliff vertical 100 feet; course south 70 west.
38	15, 16	Sienitic granite, protogine; resembles 10, but coarser grained; reddish; constituents quartz, felspar, talcose mineral.
39	15, 16	Same as 36; dike, 60 feet high; course east and west.
40	15, 16	Same as 1; hill 400 feet.
41	15, 16	Same as 1 (nearly;) hill 300 feet.
42	15, 16	Same as 1.
43	10, 15	Same as 11; dike?
44	10, 15	Sienitic granite, grayish white; very little hornblende; the felspar partially decomposed; granular.
45	9, 10	Quartzose rock, grayish red; metamorphic? south side of stream.
46	9, 10	Metamorphic rock, yellowish brown; soft, sub-compact; west side of 45.
47	9, 10	Red sandrock, metamorphosed, fine grained; bank of 30 feet, upper and fine portion.
48	9, 10	Red sandstone, metamorphosed, coarse grained; bank of 30 feet, lower and coarse portion.
94	3, 10	Red sandstone, light reddish.
50	3, 4	Trappose hornblende, dark green; compact, with calc spar associated, fracture irregular; hill 330 feet.
51	3, 4	Sienitic granite, grayish red.
52	3, 4	Trappose, dark gray; sub-compact, veined. (Notes say this specimen is wanting.)
53	32, 33	Same as 22, but *darker*, with specks of iron pyrites; slope 50 feet above country below.
54	32, 33	Same as 11.
55	32, 33	Hornblendic rock, *dark gray;* sub-crystalline, fracture irregular.
56	32, 33	Same as 50, except no spar; cliff 20 feet.
57	28, 33	Same as 36; dike? course east and west.
58	28, 33	Sienitic granite, felspathic, felspar bright red, and gives predominant color to the specimens; south side of 57, var. 1 deg. 41 min.; 2 chains, var. 2 deg. 15 min; at 4¼ chains, var. 7 deg. 5 min.
59	28, 33	Same as 36; dike same as 57?
60	28, 29	Same as 56, with specks of iron pyrites; small knob, summit.
61	28, 29	Same as 56, with specks of iron pyrites; cliff of broken rocks 30 feet; course north and east.
62	28, 29	Same as 45, but more gray, metamorphic; stream falls 20 feet over this rock.
63	28, 29	Slaty, sub-talcose rock, soft, greenish brown; supposed vein 2 or 3 feet; course east and west, in 62.
64	28, 29	Hyaline quartz, with other mineral; vein 2 or 3 inches in 63.

Catalogue of geological specimens—Continued.

No. of specimen.	Between sections	
65	28, 29	Same as 11; broken cliff of 70 feet.
66	28, 29	Hornblende rock, dark green; sub-crystalline, sub-slaty; fracture irregular, conchoidal; specks of iron pyrites; broken cliff 60 feet; course north-northeast.
67	21, 28	Same as 1; small uplift.
68	21, 28	Same as 6; fracture irregular; small uplift.
69	21, 28	Hornblendic and talcose, dark gray; sub compact; soft.
70	20, 21	Same as 69, but more hard and hornblendic; mottled, dark reddish; eastern slope.
71	20, 21	Same as 25; north side of hill 550 feet. Rock of this hill all trap except a small part like specimen.
72	16, 21	Same as 25, with a little iron pyrites; ridge 500 feet.
73	16, 21	Same as 72, with a dingy green mineral.
74	9, 16	Same as 51; steep descent north.
75	9, 16	Same as 51, but more whitish gray.
76	9, 16	Hornblendic rock, dark green and crystalline, in small crystals in a white amorphous quartz, giving the specimen a spotted appearance; tough; east side of uplift; course north and south.
77	9, 16	Same as 22 and 45; metamorphic; (?) from east side of 76.
78	8, 9	Same as 31 and 20; bank 50 feet; facing southeast.
79	8, 9	Same as 36, but crystals of hornblende layer; broken hill 100 feet above surrounding country.
80	8, 9	Same as 13; cliff 70 feet; (hill is 275 feet.)
81	4, 5	Hornblende slate, fine grained, dark gray, with small veins of quartz.
82	4, 5	Hornblende slate, fine grained, dark brown.
83	4, 5	Same as 39 and 36.
84	4, 5	Sienitic granite, fine grained, mixed white, red, bright green, and dark green grains; 81, 82, 83, and 84, bare, smooth; wooded hill 350 feet. These are from the summit; characteristic specimens, rock is of part strata, dipping north 25 deg., west 50 deg.; waved.
85	4, 5	Mostly quartz and felspar, with a little talc mineral, white and opaque; vein 2 feet run across 81—84.
86	4, 5	Sienite, with large crystals of hornblende, the latter in largest proportion, dark green; hill 30 feet summit.
87	31, 32	Compact trap, greenish black; fracture irregular; broken ledge 20 feet above surrounding surface.
88	31, 32	Trappose rock, dark reddish gray, sub-granular; broken ledge 80 feet above surface; course east and west.
89	29, 32	Same as 72, with iron pyrites; north part of slope, 30 feet, cleaves its slaty masses 2 or 3 inches thick.
90	29, 32	Hyaline quartz, associated with greenish vein 6 to to 8 inches, in 89; course southwest; dip southeast.
91	29, 32	Similar to 16; fibrous, sub-slaty; broken cliff north 10 deg.
92	30, 31	Similar to 16; less fibrous, sub-slaty, compact.
93	30, 31	Similar to 16; less fibrous, sub-slaty, compact; hill 800 feet above Lake Superior.
94	29, 30	Same as 20, but not associated with felspar and quartz; some iron pyrites south side of hill 20 feet.
95	29, 30	Same as 20; a little iron pyrites; broken hill 50 feet summit.
96	20, 29	Same as 91; a little iron pyrites; broken hill 30 feet, east side.
97	19, 30	Same as 94; ravine from stream running over this rock.
98	19, 30	Sienitic hornblende rock, shield white and black; hornblende only in distinct grains.
99	19, 20	Same as 92, (heavy;) ravine.
100	19, 20	Same as 89, (no pyrites.) Hill 650 feet above Lake Superior, var. 4 deg. 30 min. east.
101	17, 20	Trap, compact, dark gray.
102	17, 20	Metamorphic light gray substance, somewhat friable, fracture conchoidal. Land descending north, outcrop fresh.

Catalogue of geological specimens—Continued.

No. of specimen.	Between sections	
103	17, 20	Talcose rock, light gray, quite soft; fracture earthy, soapy feel. Bed of stream.
104	18, 19	Same as 54, 55, with thin quartzose vein surface.
105	18, 19	Same as 92; cleaving joints on two sides, largely conchoidal, and parallel. Stream over this rock.
106	18, 19	Quartzose rock, whitish red, granitoidal.
107	18, 19	Hyaline quartz, associated with porous rocky matter; 106 and 107. Vein in 105 several feet wide, north and south.
108	18, 19	Same as 100, with iron pyrites. Bed of stream.
109	18, 19	Quartz, semi-amethystine; fracture large, conchoidal. Vein 12 feet, course east and west, or north of west.
110	18, 19	Same as 92 and 93. Rock of south side of vein 109.
111	18, 19	Sienitic granite, same as 5. Rock of north side of vein 109.
112	17, 18	Same as 15, fracture conchoidal, with iron pyrites. Hill east side.
113	17, 18	Same as 36 nearly, fracture irregular across cleavage lines, which are large; conchoidal; sub-granite.
114	17, 18	Same as 87. Uplift.
115	7, 8	Same as 26. Cliff of 15 feet on north side stream.
116	7, 8	Same as 27. Outcrop.
117	5, 8	Same as 101. Fracture irregular.
118	5, 8	Sienitic granite, reddish, fine-grained. } Rock over which stream falls 40 feet: characteristic specimens with 122
119	5, 8	Same as 87. }
120	5, 8	Gneissoid granite, fine-grained, light gray. }
121	5, 8	Granitic quartz in large grains, with greenish and brownish rock. Vein in rock 118, 122.
122	5, 8	Same as 68; much pyrites, from rock of 118, 119, 120.
123	5, 8	Same as 91, with associated quartz in vein.
124	6, 7	Same as 92, with associated quartz in vein, and much iron pyrites. Ravine, very hard rock.
125	6, 7	Same as 62. Ravine, very hard rock.
126	6, 7	Same as 91, associated with granitic quartz and some iron pyrites.
127	Coast meand.	Red sandrock.
128	.....do.....	Red sandrock; light gray fracture, and coarse.
129	.....do.....	Red sandrock.
		Small lake, No. 1, same as 53; no iron pyrites.
		Small lake, No. 2, sienitic granite, fracture large, conchoidal; iron pyrites.
		Township 50 *north, range* 25 *west.*
		Island in section 22.
1	Coast meand.	Sienitic felspar, red color.
2	.....do.....	Trap, compact.
3	.....do.....	Same as 1, but more felspar.
4	.....do.....	Trap.
5	.....do.....	Spar vein, in trappose sienite.
6	.....do.....	Calc spar.
7	.....do.....	Trap, very black, close-grained.
8	.....do.....	Trap, greenstone.
9	.....do.....	Felspathic trappose rock.
10	.....do.....	Sparry trappose rock.
11	.....do.....	Same as No. 3.
12	.....do.....	Compact trap.
13	.....do.....	Compact trap, with iron pyrites in small specks.
14	.....do.....	Compact greenstone, with iron pyrites in small specks.
15	.....do.....	Same as 13.
16	.....do.....	Same as 3; augitic.

Catalogue of geological specimens—Continued.

No. of specimen.	Between sections	
		Township 50 north, range 26 west.
1	31, 32	Sienitic granite, gneissoid, dark grayish green; hornblende in largest proportion. Small knob.
2	31, 32	Sienitic granite, light gray; less hornblende; rocky ridge, west side
3	31, 32	Sienitic granite, same as 1, fine-grained; rocky ridge, west side.
4	19, 30	Sienitic granite, same as 1, with veins of quartz.
5	19, 30	Sienitic granite, fine-grained, gneissoidal.
6	32, 33	Sienitic granite, reddish felspathic.
7	32, 33	Hornblendic trap, fine-grained, hard, compact, dark green; fracture irregular; conchoidal, with small fractures. [Garlic river falls 50 feet over these rocks, (specimens 6 and 7,) mixed white; are imperfectly stratified, and dips east 20 deg; and are very hard.]
8	29, 32	Same as 1; rock of similar character.
9	29, 32	Sienitic granite, light gray.
10	20, 21	Hornblende trap, compact, dark gray, with quartzose vein.
11	20, 21	Quartzite rock, dark reddish gray; fracture conchoidal; 10 and 11, from rocks 50 feet above small lake, summit of west point.
12	27, 28	Hornblende rock, fine-grained, associated with felspathic granite; the latter reddish.
13	27, 28	Same as 7; 12 and 13 from hill summit; No. 13 predominant rock.
14	27, 28	Same as 7; hill 250 feet, summit.
15	27, 28	Quartzite; veins in 14.
16	21, 28	Trappose hornblende, sup. *prev.*, (?) dark gray.
17	21, 28	Quartzite, sub-crystaline, reddish gray. [Specimens 16 and 17—hill 200 feet, summit; conical, bare and smooth, mixed rock; 16 predominates]
18	34, 35	Same as 7.
19	27, 34	Slaty trap, dark, sub-granular.
20	Lake meand.	Soft shale, light red.
21	.....do.....	Sandrock, coarse white and gray, in veins.
22	.....do.....	Shale, light gray and red.
23	.....do.....	Sandrock, red, fine-grained, with small light gray spots.
24	.....do.....	Trappose rock, green, sub-granular, with small quartzose veins.
25	.....do.....	Steatite granite, greenish red.
26	.....do.....	Quartzose rock, light green, probably metamorphic.
27	.....do.....	Trappose, *dirty gray*, fine-grained, a little mica.
28	.....do.....	Calc spar, associated with trap.
29	.....do.....	Hornblende trap, compact, fine-grained, dark; resembles 13.
30	.....do.....	Sienitic granite, reddish gray, fine-grained.
31	.....do.....	Hyaline quartz
32	.....do.....	Red sandrock, metamorphosed. (?)
33	.....do.....	Red sandrock, fine-grained.
34	.....do.....	Red sandrock, very coarse, metamorphosed, partly colored by copper; cement in part composed of calc spar; effervesces briskly in nitric acid.
35	.....do.....	Same as 13, 7.
36	.....do.....	Trap reddish-black, sub-granular, semi-stratified.
37	.....do.....	Metamorphic rock, whitish-gray and red, very friable; does not effervesce with acid.
38	.....do.....	Red sandrock.
39	.....do.....	Sienitic granite, very quartzose, dark gray, fine-grained.
40	.....do.....	Hornblende slate, vein in granite.
41	.....do.....	Trap, fine-grained, very compact; fracture sub-conchoidal.
42	.....do.....	Trap, fine grained, greenish hornblendic, *dark*; associated with granular gray quartzite.
43	.....do.....	Same as trap portion of 42; fracture irregular, conchoidal.
44	.....do.....	Sienitic granite, light gray; 2d specimen reddish-gray, very quartzite.

Catalogue of geological specimens—Continued.

No. of specimen.	On sections	
45	Lake meand.	Granite, reddish-gray.
46	.....do.....	Metamorphic sandrock, coarse-grained, light reddish-gray, with white coating; but does not effervesce.
47	.....do.....	Same as 43.
48	.....do.....	Sienitic granite, reddish-gray.
		Township 51 *north, range* 26 *west.*
	Meanders sec.	
1	34	Sandrock, coarse red-gray; coast; height 20 feet.
2	27	Sandrock, metamorphic, brown; junction with primary; hor.
3	27	Sienite, with quartzose vein; height 25 feet.
4	27	Sienite, reddish; height 25 feet.
5	27	Sienite, grayish red, close-grained; predominant rock; apparently stratified; dip north 80 deg.
6	27	Sienite, grayish red; quartzose, stratified; dip north 80 deg.
7	27	Sienite, apparently hornblende slate, portions of stratified.
8	27	Sienite, chiefly quartz and felspar veins in 5 and 6; irregular in size and direction.
9	27	Quartz, greasy, white; vein 2 feet thick; course south, 20 west; dip north 70 deg., west 70 deg.
10	27	Sienite and hornblende slate, mingled with quartz.
11	27	Sandrock, red, micaceous, fine; cliff 8 feet; from upper stratum of 4 feet.
12	27	Sandrock, white, coarse; cliff 8 feet; from lower stratum of 4 feet.

Catalogue of geological specimens—Continued.

No. of specimen.	Between sections	Distance. Chs.	lks.	
				Township 51 north, range 27 west.
1	13	River		Red sandrock.
2	34, 35	....do....		Augitic rock; var.; drillage.
3	34, 35	17	95	Felspar and quartz.
4	34, 35	44	00	Sienite, very light gray; north slope of rocks.
5	34, 35	44	00	Sienite, sub-gneissoid; north slope of rocks.
6	26, 35	56	00	Sienite, gray-red, predominant rock; augitic takes place of hornblende.
7	26, 35	56	00	Mostly hornblende, in sub-ascidular crystals; spots and stripes in 6.
8	26, 35	.....		No specimen.
9	11, 14	4	50	Sandrock, white-red, metamorphic; former coast of lake; cliff 25 feet.
10	33, 34	20	00	Sienite; portions of the quartz red; southeast side of rocky hill.
11	33, 34	49	10	Sienite, gray, east side of summit of hill, 350 feet above Lake Superior.
12	33, 34	69	50	Red sandrock, north side of hill; apparently in place.
13	27, 34	45	00	Sienite, (augitic,) southeast side of hill.
14	27, 34	70	65	Sienite.
15	27, 28	3	00	Sienite, fine-grained, gray; summit of broken hill, 400 feet above lake; predominant specimen.
16	27, 28	35	00	Sienite; lamellar; drillage.
17	27, 28	35	00	Same as 6. [Summit of rounded hills (specimens 16 and 17) 350 feet; No. 17 is predominant rocks; No. 16 only occasionally.]
18	27, 28	40	00	Sienite, as 6; sub-gneissoidal.
19	28, 33	29	50	Sienite, as 6; sub-gneissoidal, with veins of quartz and felspar.
20	28, 29	67	00	Sienite, as 6; ravine southeast side of hill.
21	20, 21	10	00	Red sandrock; ravine 40 feet; stream over this rock in laminæ 2 or 3 inches thick.
22	31, 32	2	25	Sienite, light gray, fine-grained.
23	30, 31	42	10	Sienite, reddish; granite on north side of dike 24.
24	30, 31	42	00	Greenstone; dike on south side of hill in cliffs; course east-southeast, nearly vertical, with smooth, fine, and plain demarcation.
25	30, 31	42	10	Calc spar, with schist in augitic rock.
26	30, 31	42	10	Metamorphic.
27	30, 31	42	10	Radiated quartz, in crystals, with trap.
28	30, 31	42	10	Trap, compact; 25, 26, 27, and 28, are from seam between 23 and 24, 3 or 4 feet thick; spar veinstone, and 27 predominates.
29	30, 31	46	00	Sienite, red-gray; summit of rounded hill 500 feet above Lake Superior, and 200 feet on south side; cliffs of 20 to 80 feet.
30	20, 29	15	00	Sandrock, red-mottled, with mica; bed of stream.
31	20, 29	61	00	Sienite, gray-red; descend ledge 30 feet.
32	20, 29	61	00	Augitic sienite, gneissoidal; irregular veins and segregated in 31.
33	20, 29	66	00	Sienite, red-white.
34	19, 20	60	00	Slaty hornblende, or diologe; base of southwest side of hill, rock trappose and apparently stratified; dip north 60 deg
35	19, 20	60	00	Quartzose vein; small seams between the strata of 34.
36	19, 20	70	00	As 32; summit 550 feet above Lake Superior.
37	18, 19	70	00	As 33, south of summit of hill.
38	18, 19	14	77	Augitic sienite, foot of steep descent.
39	18, 19	71	40	Augitic sienite, gneissoidal, summit of hills 550 feet above Lake Superior.

Catalogue of geological specimens—Continued.

No. of specimen.	Between sections	Distance.	
		Chs. *lks.*	
40	18, 19	75 00	Trap, compact; fracture conchoidal; vein a dike 8 inches, nearly vertical; course southwest; very compact and tough.
41	17, 18	19 50	As 31; eastern escarpment of hill.
42	7, 18 Meand. L.S	2 00	As 31; commence descending east.
43	12	11 00	Sandrock, red and gray; coast of Lake Superior 4 feet.
44	9	6 40	Sandrock, brown; coast of Lake Superior 4 feet.
45	9	.....	Sandrock, as 43; hard; coast of Lake Superior 8 feet.
46	4	.....	Metamorphic; probably belongs to sienite beneath the sandrock.
47	4	.....	Sandrock, metamorphic, brown, overlying 45.
48	4	.....	Sienite, metamorphic, adjoining 49, 50, 51, and 52.
49	4	.....	Greenstone, metamorphic?
50	4	.....	Trap, compact.
51	4	.....	As 49.
52	4	.....	Greenstone, or metamorphic sienite.
			Dike in adjoining 46; course south 75 deg. west, on north side, vertical characteristic specimen. This dike is jointed in small rhomboidal blocks and cleaves nearly vertical, at right-angles with the dike.
53	4	.....	Same as 50; north side of the dike.
54	4	.....	Sienite, red brown, vitreous las., north side of dike.
55	4	.....	Calc spar, with trappose rock.
56	4	.....	Radiated quartz, with calc spar.
57	4	.....	Felspar, var. *glassy*, transparent, red vitreous.
			From irregular segregated vein on point of the dike, ½ to 2 inches thick.
58	4	.....	Greenstone; trap vein 12 inches thick; dip north 70 deg.
59	4	.....	Sienite, greenish gray; rock containing 58.
60	4	.....	Augitic rock; vein 6 inches thick; course north 75 deg. west; dip north 70 deg.
61	4	.....	Sienite, gray; rock adjoining 60.
62	4	.....	Quartz; greasy, greenish.
63	4	.....	Augite.
			Walls of dike; course north 55 deg. west; dip north 70 deg.
64	4	.....	Sienite, as 59; rock containing dike.
65	4	.....	Quartz, greasy; vein 3 or 4 inches thick; course north 80 deg. west; dip north 70 deg; irregular.
66	4	.....	Sienite, greenish red; seam 6 to 12 inches, south side of gorge of conglomerate.
67	4	.....	Calc spar, in veins through sienite, metamorphic; mass 6 inches thick between granite and conglomerate.
68	4	.....	Apparently metamorphic; sub-talcose.
69	4	.....	As 54.
			Rocky outside 67.
70	4	.....	As 61; predominant rock; dip north 60 deg.
71	4	.....	As 68; the felspar appears decomposed. Metamorphosed at junction with sandrock.
72	4	.....	As 54.
73	4	.....	As 54, but coarser.
			At junction with sandrock.
74	4	.....	Conglomerate sandrock, metamorphic, overlying the granite, 71, 72, 73.
75	4	.....	Brown sandrock, fine metamorphic.

NOTE.—In the sienitic rocks of this township, augite or dialloge frequently takes the place of hornblende. The proportion of either is, however, much more rare than of felspar and quartz, of which the latter is most abundant. Augite or hornblende is sometimes found in distinct masses.

Catalogue of geological specimens—Continued.

No. of specimen.	Between sections	Distance. Chs.	Distance. lks.	
				Township 51 north, range 28 west.
1	35, 36	44	50	Sienitic granite, light gray, quartz, felspar, hornblende, with iron pyrites, ascend hill.
2	35, 36	59	00	Sienitic granite, light gray, semi-gneissoidal; summit, broken range of hills, 530 feet.
3	35, 36	65	00	Greenstone trap, *dark* gray, fine-grained; seen for one chain; breaks in rectangular prisms.
4	35, 36	80	00	Greenstone trap, *dark* gray; slaty, argillaceous.
5	25, 26	22	00	Hornblende, with patches of granite, ascending rocky hills.
6	25, 26	41	00	Trappose sienite, *dark* gray, (iron pyrites;) summit of ascent 600 feet; whole point of hill 720 feet.
7	25, 26	61	00	Sienite, light gray, fine-grained; gneissoidal; descend hill.
8	25, 26	54	50	Sienite, *dark* gray, fine-grained; gneissoid, hornblende, quartz, and felspar, summit of ridge; course east and west 440 feet, and 200 above swamp.
9	25, 26	65	00	Trappose hornblende, *dark* gray, with iron pyrites; summit of ridge 420 feet.
10	25, 26	71	00	Sienite, reddish gray, fine-grained; summit of ridge elongated 400 feet, east and west.
11	24, 25	10	00	Sienite, gray, *fine-grained;* gneissoidal; ascend rocky hill.
12	24, 25	45	00	Greenstone trap, *crystalline*, with iron pyrites; ridge north-northwest 550 feet, and 250 above surrounding country.
13	24, 25	46	50	Trappose sienite, dark gray; side of ravine filled with fallen blocks.
14	24, 25	74	00	Trappose hornblende, fine-grained; iron pyrites; descend slope of rocks 60 feet in one chain.
15	23, 24	7	50	Sienite, reddish gray, fine-grained; ascend broken ledge 40 feet high.
16	23, 24	25	00	Slaty hornblende, crystalline, northwest side of elongated hill 500 feet General specimen.
17	23, 24	25	00	Same as 15, sub-gneissoidal, interstratified with 16; dip north-northeast 45 deg.
18	23, 24	42	00	Trappose hornblende, compact, jointed; ravine 25 feet deep.
19	23, 24	48	00	Sienitic granite; coarse-grained hornblende.
20	13, 24	7	00	Sienite, *light* gray, *fine grained;* massively stratified; dip north-northeast 45 deg.
21	13, 24	7	00	Sienite, coarse and fine-grained; portions intermixed of sienitic granite and true granite, and small veins or masses in 20; common.
22	13, 24	33	00	Slaty hornblende in prismatic crystals, *dark;* rocks dip north-northeast 45 deg. to 60 deg. General specimen.
23	13, 24	49	00	Chloritic slate, argillaceous; slaty; dip north 40 deg. General specimen.
24	13, 24	49	00	Granite, mostly white and red quartz, with red oxide of iron? vein in 23, 4 inches.
25	13, 14	20	00	Sienite, gray, fine grained.
26	12, 13	1	50	Sienite, dark reddish gray; grained trappose; summit of smooth, bare, rounded hill, 400 feet.
27	12, 13	10	00	Hornblendic, trappose, dark, with quartz in small stripes and veins, west side of hill; dip northeast. General specimen.
28	1, 2	66	00	Same as 25; east point of rocks 20 feet high—250 feet.
29	34, 35	67	00	Sienite, *dark gray;* mostly hornblende, veined with quartz.
30	26, 35	48	00	Sienite, gray; steep ascent of bare rocks 60 feet high.
31	26, 35	75	00	Same as 29.
32	26, 27	13	00	Sienite, dark reddish gray, fine-grained, northwest side of broken, rocky hill.
33	26, 27	73	00	Sienite, light reddish gray, fine-grained; rocky ravine.
34	23, 26	2	00	Sienite, light gray, fine grained.
35	23, 26	33	90	Do do do.

Catalogue of geological specimens—Continued.

No. of specimen.	Between sections	Distance. Chs.	Distance. lks.	
36	22, 23	25	00	Sienite, *light gray*, fine grained; bare rocks.
37	22, 23	46	00	Sienite, *light gray*, fine grained; summit smooth; rounded 650 feet; dip north 45 deg.
38	14, 15	22	00	Trap, dark green; compact, fine-grained, with iron pyrites; dike?
39	14, 15	22	00	Smoky quartz.
40	14, 15	22	00	Chloritic slate, dark green; small seam or vein north side of dike.
41	14, 15	22	00	Sienite, reddish gray, fine grained rock, traversed by dike and veins; 38, 39, 40; general specimens.
42	14, 15	40	00	Sienite, light gray, fine grained; steep rocky hill side; dip north 50 deg.; general specimen.
43	14, 15	65	00	Sienite, gray.
44	14, 15	79	00	Trappose, hornblende, dark, with patch of felspar; dike ascending broken cliff 20 feet high; south side of dike of 50 feet, course north of east; dip vertical.
45	14, 15	79	00	Sienite, reddish gray; gneissoid; south of dike 44.
46	14, 15	79	00	Same as 43; north of dike 44, massively stratified; dip north 45 deg. to 60 deg.; edges from steps rounded.
47	11, 14	39	50	Red argillaceous shale, belongs to the sandrock; fragments filling the soil.
48	11, 14	55	00	Same as 43 and 46; steep and bare ascent.
49	11, 14	55	00	Hornblendic trap, *dark*, compact; dike 6 feet, 40 lks. north of 48.
50	11, 14	70	00	Hornblendic, *dark* slaty; same as 44 and 49, nearly.
51	11, 14	70	00	Same as 43, nearly; rock traversed by dike 49 deg. to 50 deg.
52	10, 11	32	00	Same as 32, and gneissoidal; descend broken ledge.
53	2, 11	20	00	Same as 43 and 46; steep ascent.
54	2, 11	53	00	Sienite, dark gray.
55	2, 3	4	00	Sienite red; summit of ridge, east and west, 300 feet; 100 feet high.
56	27, 28	35	00	Sienite, light greenish white, fine grained; summit of ridge 500 feet.
57	27, 28	40	00	Sienite, light gray, fine grained.
58	22, 27	30	00	Same as 55; steep ascent of bare rocks.
59	22, 27	40	00	Sienite, light gray.
60	22, 27	62	00	Sienite, light gray, gneissoidal; dip vertical; cliff 60 feet high, north-northwest.
61	22, 27	64	00	Sienite, quartzose; vein 1 foot north and south; dip vertical
62	22, 27	64	00	Sienite, fine grained; rock containing vein 61.
63	22, 27	64	00	Trappose hornblende, soft, dark green, interstratified with the vein and rock. (?)
64	21, 22	57	50	Same as 60; east point of ridge.
65	21, 22	73	00	Sienite, light reddish gray, fine grained; summit of hill 450 feet.
66	15, 22	40	00	Same as 22; (hornblende slate,) massively stratified; dip north 45 deg.; general specimen.
67	15, 22	63	00	Sienite, dark gray.
68	15, 16	3	00	Hornblendic and micaceous schist, fine grained; both hornblendic and micaceous, dark.
69	15, 16	34	50	Same as 22 and 66; (hornblende, slate dark.)
70	15, 16	34	50	Same as 68, but the hornblende and mica more distinctly separate, and the mica bright colored.
71	15, 16	34	50	Part reddish felspar sienite; the other dark slaty hornblende, with iron pyrites.
7	15, 16	34	50	Sienitic granite, coarse grained. [Characteristic specimens of the rocks over which stream falls (in specimens 69, 70, 71 and 72) in ravine 30 feet deep. The several varieties are mixed and interlaminated; 69 and 70 predominate; dip north 45 deg.]

Catalogue of geological specimens—Continued.

No. of specimen.	Between sections	Distance.	
		Chs. *lks.*	
73	10, 15	14 00	Sienite, mixed red and dark gray; summit of ridge.
74	10, 15	15 00	Same as 22 and 26, with small quartzose vein in red and white bands, steep part of side hill; the vein is of common occurrence; general specimen.
75	10, 15	15 00	Sienitic granite, mostly quartz, the felspar having apparently disintegrated, being open cells; small veins or seams in 74; dip northeast 50 deg.
76	10, 15	16 00	Same as 49 and 50; bare rocks.
77	28, 29	59 60	Sienite, gray, fine-grained; summit of rocky hill 600 feet.
78	28, 29	78 00	Sienite, reddish, fine grained, bed of stream.
79	21, 28	30 00	Same as 77; massively stratified; dip north 25 deg.
80	20, 21	52 00	Same as 77; *fine-grained* bare rock.
81	20, 21	64 00	Same as 77; *dark* compact, fine-grained.
82	20, 21	64 00	Same as 78.
			These rocks graduate into each other without distinct line of separation; 81 on southeast, 82 on northwest.
83	16, 21	13 00	Same as 77; general specimen, but interstratified or mixed with 84; dip northerly.
84	16, 21	13 00	Hornblende slate, *dark*, in fine crystals.
85	16, 21	13 00	Sienite, *coarse-grained*, felspathic, veined with quartz; very common in small masses in the other rocks.
86	16, 21	54 00	Sienite, fine-grained, reddish; small knob.
87	16, 17	38 50	Same as 56; summit of rocky ridge 600 feet south-southeast; general specimen.
88	16, 17	38 50	Same as 84, interstratified with 87; all dip northeast or north-northeast 45 to 60 deg.
89	4, 5	S. 6 00	Same as 44, (trappose hornblende;) dike 6 feet; east and west; dip vertical.
90	4, 5	10 00	Same as 85; felspar predominates; summit of ridge; course east and west; descent east 500 feet.
91	4, 5	13 00	Sienite, coarse-grained, reddish, descending broken cliff; dip north 25 deg.
92	20, 29	31 00	Greenstone trap in distinct grains; broken ledge on north side of rounded hill.
93	20, 29	44 50	Sienite, gray, descending ledge north-northeast.
94	19, 30	E 70 00	Sienite, gray, *fine-grained*.
95	19, 20	76 00	Hornblende slate, (as 66;) steep descent north.
96	18, 19	12 00	Hornblendic sienite, slaty, trappose, resembling micaceous schist; dip north 40 deg.; general specimen.
97	18, 19	12 00	Same as 85 and 90, in small patches or irregular veins.
98	18, 19	42 00	Hornblende, fine-grained, with veins of quartz; rounded hill 700 feet; dip north-northeast 40 deg.; general specimen.
99	18, 19	42 00	Same as 85 and 90; felspar and quartz, masses and veins, in 98.
100	17, 18	37 00	Same as 71; sienitic hornblende, but no pyrites; ascend small ledge; dip north 40 deg.
101	8, 17	74 00	Same as 85, 90, and 99; mostly felspar.
102	8, 17	74 00	Hornblende, dark green, fine crystals.
103	7, 18	25 00	Sienite, gray, fine-grained.
			North point of rocks.
104	7, 18	40 00	Same as 100
105	7, 18	40 00	Sienitic granite, *light*, fine-grained.
			Descend broken cliff 25 feet high; course northeast, interstratified massively; dip north 45 deg.; general specimens.
106	6, 7	6 00	Sienite, gneissoid, *fine-grained*; dark gray bare rock.
107	5, 6	1 50	Sienite, reddish gray; steep descent.
108	4	Lake	
109	4	..do.....	
110	4	..do.....	
111	3	..do.....	

Catalogue of geological specimens—Continued.

No. of specimen.	Between sections	Distance.	
		Chs. *lks.*	
112	3	Lake	
113	3	..do.....	
114	3	..do.....	
115	3	..do.....	
116	6	..do.....	
			Township 51 north, range 29 west.
1	23, 24	75 00	Light gray granite, fine-grained, summit of west point of ridge of rocks.
2	13, 24	14 00	Light red gray granite, very fine-grained; bare, steep side hill.
3	13, 24	33 20	Dark gray sienitic granite, fine-grained, gneissoidal, ascending broken ledge.
4	13, 24	33 20	Granite, coarse-grained, with large lamina of brown mica; probably portion of a vein only occasionally seen.
5	13, 14	76 00	Granite, fine-grained, light gray; small do. white; bare rocks.
6	12, 13	5 00	Sienite, very fine-grained; apparently hornblendic slate; side hill, descending west, massively stratified; dip north-northeast 45 deg.
7	12, 13	50 00	Light gray sienitic granite summit of line north side of hill.
8	11, 12	40 00	Felspar, flesh-color, south side of rocks.
9	11, 12	49 00	Quartz, hyaline, south side of rocks.
10	11, 12	44 50	Quartzose sienite, reddish gray; summit of small rocky ridge.
11	11, 12	44 50	Hornblende slates, with a little felspar; summit of small rocky ridge.
12	1, 12	10 00	Quartz, sienitic, gray, fine grained; base of rocks.
13	1, 2	40 00	Same as 12, reddish gray; general specimen.
14	1, 2	40 00	Quartz and felspar, coarse grains; forms small portion of 13.
15	14, 23	8 10	Sienite, gray, sub-gneissoidal; rocky ravine.
16	14, 15	80 00	Sienite, reddish gray; fine grained.
17	11, 14	29 50	Sienite, reddish gray, coarser; steep descent west above 100 feet.
18	11, 14	50 00	Greenstone, small broken ledge in side hill; general specimen.
19	16, 11	57 50	Sienite, very fine grained, with gneissoidal or slaty structure; bare rocks; dip north 45 deg.
20	2, 11	24 50	Sienite, red gray; coarser; small ridge.
21	2, 11	40 24	Greenstone. } Chance specimens interstratified massively, and dip north 45 deg.
22	2, 11	40 24	Sienite, chiefly quartz and felspar. }
23	3, 10	20 00	Greenstone, north part of trap rocks; very compact and tough.
24	3, 10	62 50	Sienite, light gray, fine grained. In stream over this rock.
25	3, 10	62 50	Sienite, mingled red, gray, and white, in stripes; small streaks or veins in 21.
26	3, 10	75 00	Sienite, light gray; mass stratified; dip north 45 deg.
27	3, 4	14 00	Hornblende slate; small ridge, extending from hill northwest.
28	3, 4	62 00	Sienite; the granite components much segregated. } Summit of large hill; chance specimens.
29	3, 4	62 00	Greenstone. }
30	8, 9	61 00	Sienite, flesh colored, felspathic
31	8, 9	62 75	Greenstone, outcrop of trap; small rise.
32	4, 9	64 00	Sienite, gray, fine grained; general specimen.
33	4, 9	64 00	Quartz, greasy; small irregular vein.
34	4, 9	75 00	Compact greenstone trap, dark, probably dike; apparent course, west-southwest.

Catalogue of geological specimens—Continued.

No. of specimen.	Between sections	Distance.	
		Chs. *lks.*	
35	4, 9	75 00	Sienite, chiefly quartz and felspar, reddish; rock on south side.
36	4, 5	34 00	Sienite, chiefly quartz and felspar, reddish gray; ridge oval shape; course west-northwest.
37	4, 5	50 00	Same as 35; descend broken slope, southwest side of hill; course west-northwest.
38	30, 31	37 80	Black argillaceous slate; contains some iron pyrites? crops out on west side of stream, hard and in thin layers 1-16 to ¼ inch; dip southwest 45 deg.
39	19, 30	44 20	Same as 38, but with more iron in cubic crystals; stream over edges of this rock cleaves in thin layers as above; dip south 45 deg.
40	5, 8	8 00	Greenstone trap, dark gray; north side of small rise of township.
41	6, 7	25 00	Reddish argillaceous slate; rock cleavable into layers ¼ to 1 inch; dip south or south-southwest 40 deg.
42	5, 6	52 00	Sienitic granite; constituents sub-separate; small rise.
43	1	Lake.	Sienitic granite, fine grained, light colored; shore of small lake; low point.
44	1	Lake.	Greenstone, apparently hornblende slate; shore of small lake; low point.
			Township 51 *north, range* 30 *west.*
1	23, 24	27 00	Clay slate, blue black, with cubes of iron pyrites; stream bed; strata 1 to 2 feet thick; nearly horizontal; cleavable into thin layers 1-16 to 1 inch; dip south-southwest 45 deg.
2	13, 24	14 50	Clay, dark gray; stream as above; fine grained and soft.
3	12, 13	64 30	Clay, dark gray; stream; apparent strata 1 to 2 feet thick; dip south-southwest 10 deg.
4	11, 12	35 85	Clay, dark gray. } Rapids
5	11, 12	35 85	Clay, in alternate layers of dark gray and white. } over this rock; general specimens.
6	11, 12	35 85	Quartz, vein in slate. } Vertical cliff 20
7	11, 12	35 85	Silicious rock, with decomposed matter. } feet west of stream; in —— strata, general dip south 20 deg.; veins in the rock.
8	1, 12	32 80	Clay slate, black; bed of stream; rock cleavable into thin layers; dip southwest 40 deg.; very fissile.
9	22, 23	68 20	Clay slate, very dark gray. } Bed of
10	22, 23	68 20	Clay slate, very dark, with veins of iron pyrites. } stream; general specimens.
11	22, 23	68 20	Hard trappose rock, 1 chain southwest of above, at falls.
12	22, 23	68 20	Clay slate, hard, 1 chain southwest of falls.
13	22, 23	68 20	Same as 8; soft slate between the harder rock; cleavage dip south 30 deg.
14	14, 15	9 00	Same as 8; stream bed, strata 24 feet; dip southwest 10 deg. to 15 deg.; cleavage dip south 45 deg.
15	14, 15	59 00	Same as 5; gray, veining; stream bed rapid; strata 1 to 3 feet; dip southwest 10 deg. 20 min.; striped and cleavable into thin layers; dip southwest 45 deg.
16	14, 15	59 50	Slate clay, steatitic; broken cliff 3 chs. southeast of above.
17	14, 15	59 50	Same as 2; containing rock of 16.
18	2, 11	26 00	Same as 2, nearly. } Stream rapid over this rock; in strata
19	2, 11	26 00	Same as 2 } 1 to 2 feet; dip southwest 30 deg.; joints at right-angles with dip, and dip irregular northeast 45 deg.
20	2, 11	26 00	Clay slate, yellow gray; falls 16 feet.

Catalogue of geological specimens—Continued.

No. of specimen.	Between sections	Distance. Chs.	lks.	
21	33, 34	46	50	Greenstone trap. } Chance specimens; stream rapid
22	33, 34	46	50	Black hard clay slate. } over these rocks; apparent dip south 20 deg., west 35 deg.; cleavage dip south 20 deg., west 65 deg. to 70 deg.
23	3, 10	14	20	Clay slate, light gray or brown; rapids over this rock; part fine like 23, and part sandy.
24	3, 10	14	20	Clay slate, light gray or brown; strata 1 to 2 feet; dip south 20 deg.; cleavage dip south 45 deg. to 60 deg.
25	3, 10	14	20	Clay slate, very hard trappose; dike 18 inches; course north 70 deg. west; dip north 20 deg., east 80 deg.
26	3, 10	14	20	Clay slate, very hard; small stream south side of 25.
27	3, 10	14	20	Clay slate, greenish gray, containing rock of 26.
28	32, 33	1	00	Trap, small knob, very hard; sounds under hammer like iron.
29	16, 17	6	00	Slaty rock, hard, black; bare rock; cleavage uneven; dip south 45 deg.
30	4, 9	25	30	Clay slate, dark gray; outcrop near; horizontal strata ½ to 1½ foot; layers thin; dip south 45 deg. These stripes are always parallel with strata.
31	31, 32	56	60	Clay slate, brownish gray; layers 1-6 to 1 inch; dip south-southwest 45 deg. to 60 deg.; hard but fissile.
32	19, 30	1	00	Clay slate, black; bed of stream, cleavage 1-16 to 1 inch; dip south-southwest 45 deg. to 60 deg.
33	19, 30	43	25	Clay slate, black, colored by iron; bed of stream, horizontal strata 1 to 2 feet; layers thin; dip south 45 deg. to 60 deg.
34	19, 20	13	00	Clay slate; same as 32; bed of stream, cleavage dip south-southeast 45 deg.
35	8, 17	45	50	Trap, or altered slate, dark gray; trappose apparently.
36	5, 6	52	50	Greenstone, dark gray; summit of west end of small rounded knob 40 feet; very hard.
				Township 51 *north, range* 31 *west.*
1	35, 36	75	00	Greenstone, dark gray, compact; small knob 15 feet (50 links west.)
2	24, 25	3	00	Black agillaceous slate, discolored by iron; general specimen from small ravine in slate; dip south 45 deg. to 60 deg.
3	24, 25	3	00	Quartzite, probably vein, 50 lks. south of above.
4	24, 25	3	00	Quartz, greasy white, with much iron pyrites, 150 lks. south of above; vein 10 inches; course east and west.
5	24, 25	3	00	Trappose rock, black, fine-grained, containing rock of 4. All these rocks ——; cleavage uneven, dip south 45 deg. to 50 deg.
6	24, 25	65	00	Same as 2. Stream brisk over this rock; cleavage thin, dip south 50 deg. to 60 deg.
7	23, 24	33	80	Argillaceous slate, dark gray. Bed of stream.
8	14, 15	2	50	Argillaceous slate, same as 7, with iron. Bed of stream, apparent dip south-southwest 20 deg. to 60 deg.; cleaves into very thin layers.
9	33, 34	48	50	Argillaceous slate, same as 2. Bed of stream, cleavage uneven, dip southwest 30 deg. to 40 deg.; fissile, joints 1 inch to 2 feet apart; course southeast, dip northeast 80 degrees.
10	27, 28	21	50	Greenstone, granular. Small outcrop, irregularly jointed, in conchoidal pieces 1 to 2 inches thick; very hard.
11	15, 22	2	50	Same as 7. Bed of stream, dip of cleavage 70 deg. south.

Catalogue of geological specimens—Continued.

No. of specimen.	Between sections	Distance.	
		Chs. lks.	
12	15, 22	67 00	Argillaceous slate, brown color. Bed of stream rapid; layers thin, one-sixteenth to one inch; dip south-southwest 40 deg.; soft; general specimen.
13	15, 16	51 90	Argillaceous slate, reddish color. . Ravine, 40 feet.
14	15, 16	5 19	Same as 12, but more compact; 5 chains southeast of 13; strata dip north-northeast 20 deg. to 30 deg., cleavage south-southwest 45 deg.
15	8, 9	52 00	Argillaceous slate, light brown. Valley, 50 feet, outcrop of soft slate; general specimen.
16	30, 31	16 00	Greenstone, sub-granular. Rise of 10 feet 3 chains north; a knob of same 30 feet, var. 5 deg. 40 min.
17	30, 31	54 92	Argillaceous slate, black. } Stream rapid
18	30, 31	54 93	Argillaceous, very compact, metamorphic? } over rock; from 1 chain north cleavable into layers from thickness of a line to 6 inches; dip southwest 60 deg.
19	30, 31	54 93	Same as 16. Northeast of, and dipping under 17 and 18.
20	30, 31	54 93	Quartzite. Small seam between 19, and 17 and 18.
21	29, 30	28 58	Slate, metamorphic, hard. Small rise.
22	29, 30	28 58	Greenstone trap, same as 16. General characteristic of rocks on the line.
23	19, 30	17 00	Greenstone trap, compact. Small knob 4 chains south, 30 feet.
24	19, 30	56 00	Greenstone trap, same as 16. Summit of knob 30 feet.
25	18, 19	62 00	Black slate, compact, fine. Bare rock; cleavage dip east-southeast 60 deg.; hard.
26	7, 18	1 00	Sienite, dark reddish gray. Bare rock, gneissoidal, with vertical lines north and south.
27	18, 00	River.....	Sandrock metamorphic, hard, white; rapids; in thin layers, course south-southwest; dip vertical.
28	18, 00	....do....	Resembles 14, but harder; 5 chains down.
29	18, 00	....do....	Metamorphose slate, 5 chains down.
			Township 52 north, range 27 west.
1	33, 00	L. Superior	Sandrock, brownish red. Coast 45 feet, and 22 feet old lake coast.
2	32, 00	....do....	Sandrock, brown, red, and white.
3	32, 00	....do....	Sandrock, brown and red, conglomerate.
4	30, 00	....do....	Sandrock, brown and red, conglomerate.
5	30, 00	....do....	Sandrock, brown and red, conglomerate.
			Township 52 north, range 28 west.
1	35, 36	35 00	Granite, greenstone. Knob bare, rounded.
2	34, 35	2 50	Sienitic granite, light gray, fine-grained; quartz, felspar, and green hornblende; descent broken, cliff 25 feet high.
3	33, 34	35 00	Sienitic granite, reddish; *fine-grained* quartz, felspar, hornblende, gneissoidal.
4	33, 34	56 00	Sienitic granite, grayish white, fine-grained, gneissoidal. Ridge east and west 300 feet.
5	32, 33	67 20	Sienitic granite, greenish red, fine-grained, trappose. Ascend broken cliff.
6	32, 33	76 50	Greenstone trap, dark gray, fine-grained, with iron pyrites. Dike south 40 deg. east, dip vertical.
7	32, 33	76 50	Sienite, light grayish red, grained. Rock containing 6.
8	32, 33	78 00	Trap, dark, compact, hard; iron pyrites; dike; breaks in direction of cleavage joints.

Catalogue of geological specimens—Continued.

No. of specimen.	Between sections	Distance.	
		Chs. *lks.*	
9	32, 33	78 00	Sienite, light grayish green, *fine grained*, on NE. side of 8.
10	32, 33	58 50	Sienite, light grayish green, *fine-grained*, ascending broken cliff 20 feet high.
11	32, 33	68 00	Sienite, light gray, coarse-grained.
12	28, 29	15 00	Sienite, gneissoid, grayish white, *fine-grained*, foot of steep descent.
13	31, 32	47 00	Slaty hornblende, *dark greenish black.* } Interstratified; dip
14	31, 32	47 00	Sienite, *dark gray*, fine-grained. } NNE. 45 deg.
15	29, 32	15 00	Same as 11, and sub-gneissoid, narrow ravine.
16	29, 32	28 00	Same as 11, and sub-gneissoid, fine-grained.
17	29, 32	60 00	Sienite, red, fine-grained, gneissoid; conical hill 650 feet.
18	29, 32	72 00	Greenstone, or trappose sienite, *dark*; general specimen.
19	29, 32	72 00	Sienite, reddish quartzose; small veins or seams in 18.
20	29, 30	57 50	Sienite, gray, *fine grained*; broken cliff 20 feet high.
21	29, 30	64 00	Sienite, light reddish gray; fine-grained gneissoidal east point of same hill 20 feet high; break into rhomboidal blocks.
22	20, 29	18 00	Sienite, light reddish gray, fine-grained, gneissoidal; broken ridge 170 feet.
23	19, 30	E.25 00	Sandrock, reddish brown, metamorphosed; head of ravine in thin laminæ; dip west 10 deg. to 20 deg.; dip of strata northerly (?)
24	19, 30	E.31 00	Sandrock, reddish brown, metamorphosed, from large block 12 by 30 feet.
25	19, 30	E 57 00	Sienite, purplish red, fine grained.
26	19, 30	E.78 00	Sienite, spotted with greenish gray and red, fine-grained.
27	25	.....	Limestone boulder.
28	25	.....	Sandrock, red.
29	24	.....	Sandrock, gray.
30	24	.....	Sandrock, red and gray.
31	23	.....	Sandrock, brown and red.
32	23	.....	Sandrock, reddish gray, with carbonate of lime; calc spar.
33	23	.....	Sandrock, reddish gray, with sulph. of copper.
34	23	.....	Sandrock, gray.
35	23	.....	Sulph. and carb. of copper.
36	23	.....	Same as 34.
37	23	.....	Same as 31.
38	23	.....	Sandrock, gray, with carb. of copper.
39	23	.....	Sandrock, red.
40	17	Lake....	Sandrock, red.
41	7	..do.....	Sandrock, brown.
42	33	..do.....	Hornblende, sub-slaty.
43	33	.....	Sienite, reddish gray.
44	34	..do.....	Sienite, reddish gray.
45	34	.....	Quartz, with talcose rock.
46	34	.....	Talcose or steatitic rock.
47	34	.....	Sienitic and steatitic rock.
48	34	.....	Greenstone.
49	34	.....	Sienite, reddish gray.
50	34	.....	Quartz, hyaline.
51	21	River.....	Sandrock, reddish gray.
52	31	Lake....	Sienite, red, mostly red felspar.
53	30	..do.....	Gneissoidal granite, dark gray.
54	30	..do.....	Sienite, dark reddish gray.
55	30	..do.....	Sienite, light reddish gray.
56	30	..do.....	Sienite, reddish gray.
57	30	..do.....	Sienite, striped hornblende, and quartz and felspar.
58	19	..do.....	Sandrock, brown, coarse.
59	19	..do.....	Sandrock, brown.

Catalogue of geological specimens—Continued.

No. of specimen.	Between sections	Distance.	
		Chs. *lks.*	*Township 52 north, range 29 west.*
1	35, 36	40 00	Sienite, light reddish gray; rocky side of hill; descen west.
2	35, 36	64 00	Sienite, dark reddish gray; summit of hill, west sid
3	25, 26	7 50	Sienite, dark gray, with considerable dark mica.
4	25, 26	49 10	Hornblende, summit of hill, about 600 feet above L perior.
5	24, 25	43 50	Hornblende, slaty, apparently actynolite; steep desc northwest point of hill; apparent dip north-north to 80 deg.
6	23, 24	3 00	Red sandrock; ravine of this rock 30 feet; cours east; in laminæ 1 to 3 inches; apparent dip nort west, 10 to 15 deg.
7	13, 14	74 10	Red sandrock, coast of Lake Superior, vertical cliff
8	34, 35	29 50	Sienite, light gray; small valley of stream.
9	26, 35	18 00	Sienite, dark reddish gray; sub-gneissoidal mass, st dip north-northeast 80 deg.
10	26, 35	28 50	Greenstone, discolored by iron, descending broken feet; course north and sout .
11	26, 35	40 20	Greenstone; rocks very compact and tough.
12	26, 35	69 50	Trappose sienite, reddish gray; dip north 35 deg.
13	26, 27	69 95	Sienite, greenish white, near summit of hill.
14	23, 26	78 00	Same as 2.
15	22, 23	6 00	Same as 1, descending steep slope 20 feet.
16	22, 23	44 50	Red sandrock; outcrop of north edge of this rock parently horizontal.
17	33, 34	51 50	Gneissoidal granite; mica, dark green.
18	27, 34	30 00	Same as 1.
19	27, 34	49 36	Same as 1; rocky, broken ravine; course north.
20	27, 28	23 50	Sienite, dark gray.
21	27, 28	30 50	Mica, in irregular laminæ, seen in small quantity c
22	27, 28	34 50	Same as 1; bare rocks.
23	27, 28	58 00	Same as 2; near summit of hill, 650 feet above l perior.
24	22, 27	42 50	Same as 1, but more red, southeast side of steep a
25	22, 27	61 50	Same as 20; rounded point of rocky ridge.
26	21, 22	58 50	Same as 1, but fine-grained; steep descent north.
27	21, 22	71 80	Brown sandrock; this rock *first* appears.
28	32, 33	Cor.	Same as 13. } General specimens.
29	32, 33	Cor.	Same as 26. }
30	32, 33	Cor.	Same as 1; coarse-grained, chiefly felspar and small masses in 28 and 29.
31	32, 33	80 00	Same as 2; sub-gneissoidal.
32	28, 33	17 50	Same as 2; compact. } Broken ledge.
33	28, 33	17 50	Same as 30. }
34	28, 33	62 00	Same as 17; southern escarpment of hill; rocks ne descending south at 60 deg; moss. strata; dip nort
35	28, 29	8 00	Same as 20, with cube of iron pyrites, foot of ledg
36	28, 29	68 00	Same as 20.
37	28, 29	73 00	Greenstone, with iron pyrites, dark greenish gray
38	21, 28	13 00	Same as 1; rocky ravine 20 feet 70 links wide.
39	21, 28	25 00	Same as 20.
40	31, 32	6 00	Same as 20; summit of small knob.
41	29, 32	25 50	Sienite, gray.
42	30, 31	79 00	Same as 20; southeast base of rocky hill.
43	29, 30	45 50	Same as 37; summit on east side of hill.
44	29, 30	80 00	Same as 20; summit of small hill.
45	20, 29	78 00	Same as 37, ascending broken ledge.
46	19, 30	17 00	Same as 20; summit of south point of rocks.
47	19, 30	34 42	Same as 20; east side of hil'.

Catalogue of geological specimens—Continued.

No. of specimen.	Between sections	Distance.	
		Chs. lks.	
48	19, 20	77 00	Same as 17; outcrop.
49	17, 20	53 70	Greenstone.
50	17, 20	55 00	Same as 2
51	18, 19	9 50	Same as 12.
52	18, 19	33 00	Same as 49. To the west lie sienitic rocks.
53	36	Lake.	Same as 1; east point of rocks at 100 feet above Lake.
54	15	Lake.	Gray sandrock, with vein of sulphuret and carbonate, and copper ore from joint mined by Franklin Company; vertical; course north 28 deg. east.
55	15	Lake.	Sandrock, reddish gray, containing rock of 54.
56	15	Lake.	Sandrock, reddish gray; conglomerate; coast.
57	16	Lake.	Sandrock, reddish gray; coarse; coast, 8 feet.
58	8	Lake.	Sandrock, as 56.
			Township 52 north, range 30 west.
1	25, 36	43 00	Sienite, coarse-grained, reddish gray. } Bare rocks.
2	25, 36	43 00	Sienite, fine-grained, dark gray } Bare rocks.
3	25, 26	36 50	Sienite, gneissoidal; striped red and gray, gneissoidal; dip north 45 deg.
4	25, 26	36 50	Quartz, with felspar, chiefly hyaline; small irregular segregated veins in ledge.
5	24, 25	2 62	Sienite, sub-gneissoidal, gray; southeast side of small ridge.
6	23, 24	40 00	Sienite, fine-grained, light red brown; small rise.
7	13, 24	16 00	Sienite, fine-grained, light red gray; west side small hill.
8	26, 35	70 50	Jaspery hornstone, reddish brown. } Huron river passes rapidly over these rocks; the different varieties much mixed; joints or cracks numerous; all the principal of which are north and south, and nearly vertical.
9	26, 35	70 50	Sienite, metamorphic; chiefly quartz and felspar; red and green.
10	26, 35	70 50	Same as 8, nearly.
11	26, 35	70 50	Hard trappose rock, flinty; dark brown.
12	26, 35	70 50	Sandrock, light gray; hard.
13	26, 35	70 50	Sienite, coarse, with hornstone.
14	22, 23	20 00	Sandrock, red and gray; broken cliff on Huron river 10 feet; dip west 10 deg. to 20 deg.
15	16, 21	53 00	Sandrock, red; bed of stream.
16	11	Lake Sup'r.	Sandrock, red, mottled with gray; coast, 8 feet.
17	10	...do....	Sandrock, light gray; gray sulphuret of copper from a joint in the cliff, mined by Franklin Company.
18	10	....do....	Sandrock, light gray, with vein; containing rock of 17; cliff here 40 feet.
19	10	....do....	Sandrock, brown and gray.
20	10	....do....	Sandrock, red and gray.
21	9	....do....	Sandrock, red, coarse.
22	6	Huron bay.	Same as 20.
			Township 52 north, range 31 west.
1	24 25	55 00	Sienite, gray; rise of 10 feet.
2	31, 32	26 00	Red, mottled sandrock; ravine, 10 feet.
3	1	Huron bay.	Red, mottled sandrock; coast broken; cliffs, 8 to 25 feet; dip northwest 5 deg. to 20 deg.; characteristic specimens.
4	18	Lake Sup'r.	Sandrock, light gray; coarse and hard. } Coast, horizontal.
5	18	....do....	Sandrock, red, fine-grained; micaceous. } Coast, horizontal.
6	7	....do....	Sandrock, reddish gray; coarse.
7	4	....do....	Sandrock, reddish gray. } Coast; chance specimens.
8	4	....do....	Sandrock, as 5. } Coast; chance specimens.

Catalogue of geological specimens—Continued.

No. of specimen.	On section	Distance.	
		Chs. lks.	
9	4	Lake Sup'r.	Shale from the sandrock, light gray; small seam in 7
10	3	....do....	Sandrock, as 4; cliff, 10 feet to 20 feet from the grained strata.
11	3	....do....	Sandrock as 5, but darker; cliff, 10 to 20 feet from th grained strata.
12	3	....do....	Sandrock, as 5; cliff, 10 to 20 feet, finest-grained.
			Township 53 north, range 29 west.—Huron isles.
1	Meander.	.....	Sienite, reddish gray.
2	....do....	.....	Trap, compact; dike.
3	....do....	.....	Greenstone trap; dike.
4	....do....	.....	Same as 1.
5	....do....	.....	Same as 1.
6	....do....	.....	Same as 1.
7	....do....	.....	Same as 1.
			Township 53 north, range 30 west.
1	31	53 50	Conglomerate sandrock, reddish brown.
2	32	Huron bay.	Sandrock, reddish brown.
3	32	....do....	Sandrock, coarse, light gray. } Broken slope 7 feet acteristic specim
4	32	....do....	Same as 2, except finer.
5	28	Lake Sup'r.	Same as 2; east end of Point Abbaye; bare rocks.
6	29	....do....	Same as 4, but mottled with gray.
7	30	....do....	Sandrock, red and gray, in layers; micaceous; bay
8	30	....do....	Conglomerate sandrock, red and gray.
			Township 53 north, range 31 west.
1	36	....do....	Sandrock, coarse, red and gray; coast, 3 to 5 feet; curved; dip northwest 5 deg. to 30 deg.; genera mens.
2	35	....do....	Sandrock, coarse, red and gray; coast, 6 feet.
3	34	....do....	Sandrock, coarse, red and gray; coast, 6 feet.

BELA HUBBARD, Ge

Catalogue of specimens collected by Wm. A. Burt, deputy surveyor, while surveying township lines under Dr. Houghton's contract, dated June 25, 1844, for surveying with reference to mines and minerals.

[Note.—This catalogue should have been inserted on the first pages of the tables of specimens, as it is first in order of time; but the notes could not be obtained in time for entry in their proper place.]

No. of specimen.	On section	
		Township 40 north, range 23 west.
1	2	Esconawba river; bird's-eye lime rock.
2	2 or 3	Do.
		South boundary of township 41 north, range 23 west.
3	35	Esconawba river.
4	35	Esconawba river; strophomena; bird's-eye lime rock.
5	31	Esconawba river; stem of encrinite, with numerous radiations, in bird's-eye lime rock.
5	32	Esconawba river.
7	23	Esconawba river; stem of encrinite; bird's-eye lime rock.
8	17	Esconawba river; cyathophyllum, &c., in bird's-eye lime rock.
9	17	Esconawba river; orthis, in bird's-eye lime rock.
10	17	Esconawba river; orthocera pyrifomis? bird's-eye lime rock.
		East boundary of township 41 north, range 24 west.
11	1	Esconawba river; coarse gray limestone, probably bird's-eye.
12	1	Esconawba river; orthocera; bird's-eye lime rock.
13	2	Esconawba river; bluish-gray sandy lime rock; bird's-eye lime rock.
14	36	Esconawba river; stem of encrinite; bird's-eye lime rock.
15	36	Esconawba river; strophomena; bird's-eye lime rock.
16	36	Do do do.
17	25	Esconawba river; orthis; bird's-eye lime rock; stem of encrinite.
		Township 42 north, range 24 west.
18	23	Esconawba river; bluish-gray lime rock, with orthis belonging to bird's-eye lime rock.
19	17	Esconawba river; bird's-eye lime rock.
20	20	Do do. No. 2, grayish-blue lime rock.
21	17	Esconawba river; calciferous sandrock; gray, sandy lime rock.
22	17	Do do.
		South boundary of township 43 north, range 26 west.
23	31	Fort river; calciferous sandrock; gray, sandy lime rock.
		East boundary of township 43 north, range 26 west.
24	1	Calciferous sandrock; gray, sandy lime rock.
		Township 43 north, range 25 west.
25	3	Esconawba river; 5 specimens of calciferous sandrock; gray lime rock.
26	3	
27	3	
		South boundary of township 46 north, range 25 west.
28	33	No. 4, gneissoid granite; No. 1, compact gray granite, without mica and with a little hornblende, (No. 2)
29	33	Granite, with red felspar and hornblende; no mica.

Catalogue of specimens—Continued.

No. of specimen.	On section	
		East boundary of township 45 north, range 26 west.
30	24	Gray sandrock.
31	24	Compact gray granite, feldspar, quartz, and schorl.
32	24	Feldspathic granite, without mica; feldspar, red.
33	24	Compact brown quartz rock.
		East boundary of township 47 north, range 26 west.
34	36	Fine-grained white and green quartz.
35	36	Brown granular quartz rock.
		East boundary of township 47 north, range 25 west.
36	1	Reddish brown quartz rock.
37	1	Semi-compact talcose slate.
38	1	Brown talcose quartz rock.
		South boundary of township 48 north, range 25 west.
39	36	Dark sub-slaty talcose rock; steatite.
40	35	Talcose slate.
41	34	River Desmorts, coarse-grained, new red sandstone.
42	34	Coarse, new red sandstone; almost conglomerate.
43	34	Taconic clay slate.
44	34	Do *b*. taconic (compact) slate.
45	32	Do
46	32	Brown quartz rock.
47	31	Brown and milky quartz rock.
		East boundary of township 47 north, range 26 west.
48	12	Compact altered slaty rock, resembling imperfect trap, with much
49	13	Compact, fine-grained, white and brown quartz rock; 2, taconic slate.
		South boundary of township 48 north, range 26 west.
50	33	River Desmorts, taconic clay slate. No. 2, variegated quartz roc
51	33	Augitic rock, crystalline.
52	31	Crystalline quartz, brown and smoky, with iron.
53	31	Crystalline quartz, brown, with iron.
54	31	No. 1, augitic rock, crystalline.
		East boundary of township 47 north, range 27 west.
55	12	Compact quartz rock; 2, quartz, with spathose iron.
56	12	No. 1, brown hematite, steel gray. No. 2, taconic clay slate.
57	12	Brown hematite, steel gray.
58	12	Quartz, with spathose iron.
59	1	Do do.
60	13	No. 1, fine, large, granulated sub-crystalline spathose iron. 1 same, with quartz. No. 3, spathose, earthy, sub-laminated i
61	24	Nos. 1 and 2, spathose iron. No. 3, hydrated carbonate of iron milky quartz and specks of mica.
62	13	Spathose iron, brown, amorphous, sub-laminated.
63	25	Near a pond, 2 specimens spathose iron, granular; sub-crystalli
64	25	Near a pond, spathose iron, granular; sub-crystalline; 2 specim
66	1	Spathose, steel gray, iron ore.

Catalogue of specimens—Continued.

No. of specimen.	On section	
		South boundary of township 47 *north, range* 26 *west.*
65	32	Branch on Esconawba, actynolite slate rock; gneissoid, with dark mica.
		Township 44 *north, range* 25 *west.*
67	21	Banks of Esconawba river, coarse red sandrock.
		Township 39 *north, range* 23 *west.*
68	1	Esconawba river, near head of island, bird's-eye lime rock, fucoides, encrinite, &c.
		Township 40 *north, range* 22 *west.*
69	.....	On bay du Nocquet, 50 chains south, fine reddish, nearly clay.
70		
71		
72		
73		
74		
75		
76		
		South boundary of township 41 *north, range* 23 *west.*
5*a*	35	Esconawba river, bird's-eye lime rock.
4*a*	35	Do.
4*a*	35	Do.
4*a*	35	Do.
		South boundary of township 40 *north, range* 23 *west.*
1*a*	2	Esconawba wilds.
1*a*	2	Do.
1*a*	2	Do.
1*a*	2	Do.

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